CAMPBELL'S BOOK

canning, pickling, preserving

4. food preparations
5. meat & poultry products
8. Quality control
9. pectin 10. vinegar

CAMPBELL'S BOOK

a manual on

Canning, Pickling and Preserving

by

CLYDE H. CAMPBELL

THIRD EDITION

revised by

ROHLAND A. ISKER

Col., U. S. Army (Ret.)
Secretary, Associates, Food and Container Institute for the Armed Forces, Chicago

and

WALTER A. MACLINN

Ph.D.
Chairman, Food Technology Dept., Rutgers University, New Brunswick, N. J.

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Preface

CLYDE HENDERSON CAMPBELL was a pioneer of his day. As one of first food technologists, he used his influence to place commercial food canning, pickling and preserving on a scientific basis. A chemical education from the University of Pittsburgh was the foundation for his life's work.

Mr. Campbell began his career at H. J. Heinz Company and for twenty years worked in food plants and laboratories and later was food chemist with the Pennsylvania State Department of Agriculture where he developed processes for detection of purity and adulteration of foods. As a public official, he took a leading and active part in formulation and adoption of over four-hundred "Food Standards and Definitions". This book has not been revised and stands today as official standards and definitions.

Mr. Campbell was among the first to see the necessity of disseminating technical knowledge developed in various food plants and laboratories. His practical knowledge of canning, pickling and preserving operations was first put in print in 1929 and was known as "Campbell's Book on Canning, Pickling and Preserving". This book was received with acclaim, both by industry and educational institutions and revised by Mr. Campbell in 1937. This edition was exhausted about the time of Mr. Campbell's death in 1946.

Since that time we have had numerous requests for a new revised edition. In cooperation with Mrs. Campbell, Colonel Rohland A. Isker and Walter A. Maclinn were persuaded to collaborate on a new edition that the industry needed and to carry on the work of Mr. Campbell.

During the first World War, Colonel Isker became interested in food preservation. As a mess officer he had first hand knowledge of the difficulties of subsisting troops. He took a special course at the QMC Subsistence School in Chicago in 1933 and later became officer-in-charge of the QMC Subsistence Research Laboratory in 1939.

The Colonel saw the results of the research he fostered during the second World War. The practical knowledge gained by measuring food requirements under actual combat resulted in the standards used by food processing concerns.

Dr. Maclinn was educated at the University of Massachusetts and Oregon State College, both of which institutions pioneered in development of Food Technology Departments. Since that time he has devoted most of his career to food research with various commercial concerns, the QMC of the Army and with educational institutions. Dr. Maclinn is now Chairman of the Food Technology Department of Rutgers University.

Herbert A. Vance
Publisher

Foreword

THE PROBLEM of obtaining food has been one that has confronted man since his inception. Nature has at times supplied him with abundance but at other times starvation has faced him. As man progressed from a savage to a civilized individual, he found means of preserving food in abundant times for his needs in times of scarcity.

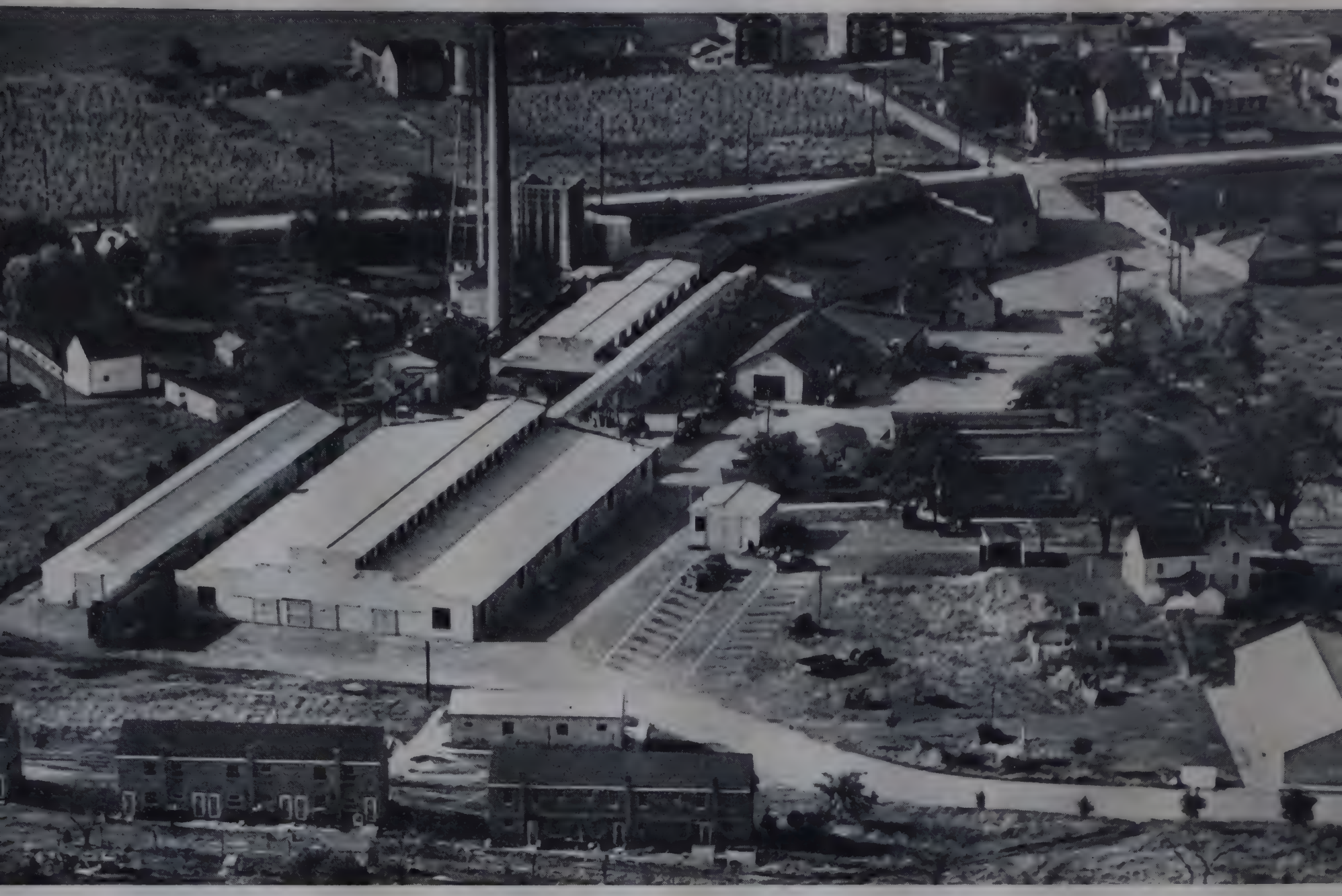
The methods used for preserving foods are designed to destroy or inhibit the action of all agents that cause spoilage. Spoilage may be that which causes the food to be unfit for human consumption or that which spoils the appearance and taste of the food and reduces its acceptance to humans. Microorganisms such as some bacteria are the usual causative agents in making foods unfit for human consumption. Yeasts and molds alter the appearance and taste of some foods to the extent that they become non-acceptable to humans. Chemical changes in foods that result in softening, darkening, and discoloration also contribute to changes in appearance and taste.

The development and success of the entire food preservation industry is a result of the inventive genius of men who have sought the basic principles of science and have applied these principles to the industry's operations. These applications can be found on the following pages.

The authors are deeply grateful to the numerous persons, who provided useful information during the preparation of this revision. Specific acknowledgment is made in the text at point of insertion. We also desire to mention the special help received from the research associates of the National Canners Association and Technical Editor E. W. Nordlinger and other members of his *Food Packer* staff. Much of the labeling information is used through the permission of the *Canning Trade Almanac.*

Chicago, Illinois
New Brunswick, N. J.
July, 1950

Rohland A. Isker
Walter A. Maclinn



Section 1—Canning

Chapter 1—Principles Involved in Canning

CANNING is a procedure whereby selected raw food materials are prepared as for the table, packed in tin or glass containers capable of being sealed airtight, heated sufficiently to destroy the spoilage agents within the container, and cooled rapidly to prevent overcooking of the product. Although the equipment used in canning is different for the various food materials, the fundamental principles of canning are the same for all commodities.

The canning procedure may be divided into nine general steps and the objective for each step is as follows:

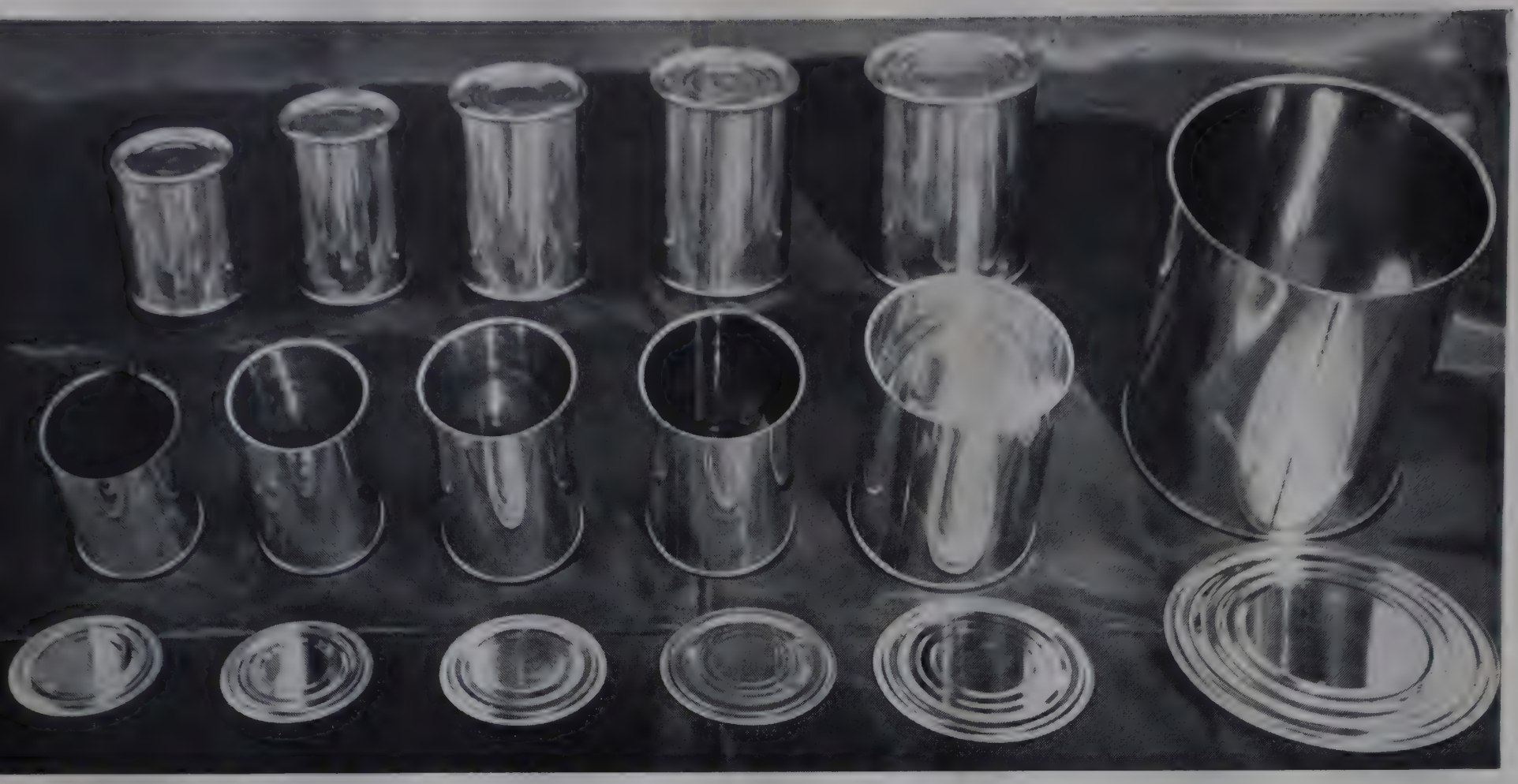
WASHING:—Objective of this step is to remove dirt and foreign material which adheres to the raw food materials or the containers. The food material is usually spray washed either on a roller belt or in a rotary drum. Soaking of the product may precede spray washing if the dirt has dried on the surfaces of the food. Containers are usually flushed with hot water in an inverted position or they are allowed to drain inverted.

PEELING:—Objective of this step is to remove inedible or undesirable parts of the food. Peeling may be accomplished by cutting with a knife or other suitable instrument either before or after blanching (precooking). Some food materials peel easier if the product has been blanched previous to peeling. Other peeling methods are rubbing and lye peeling. Rubbing is accomplished in an abrasive machine such as the potato peeler. Lye peeling is based upon the fact that a strong solution of caustic alkali will break down outer skin cells and permit easy removal of the skins. The food material is left in the alkali sufficiently long to soften the outer skin and then the alkali is removed by washing. The strength of the alkali and the length of time of immersion varies with the product. Peaches require a weak solution and a short dip while root vegetables require a strong solution for a longer period of time.

BLANCHING (precooking):—Objective of this step varies with the commodity. Blanching is done by subjecting the food material to boiling water or steam and then cooling in cold water. Not all food materials need to be blanched but those that require blanching do so for one or more of the following reasons:

1. To reduce bulk, as in greens.
2. To remove raw flavors, as in some green vegetables.
3. To expel gases.
4. To facilitate handling and packing, as in asparagus.
5. To aid preservation, as some spoilage agents are killed at blanching temperatures.
6. To aid in the removal of skins, as in tomatoes.

PACKING (filling):—Objective of this step is to get the material into the container so that the finished product will sterilize properly, be of the grade desired, and conform to Federal regulations of cleanliness, fill, etc. Plain water, salt brine, or sugar syrup is usually added to fruits and vegeta-

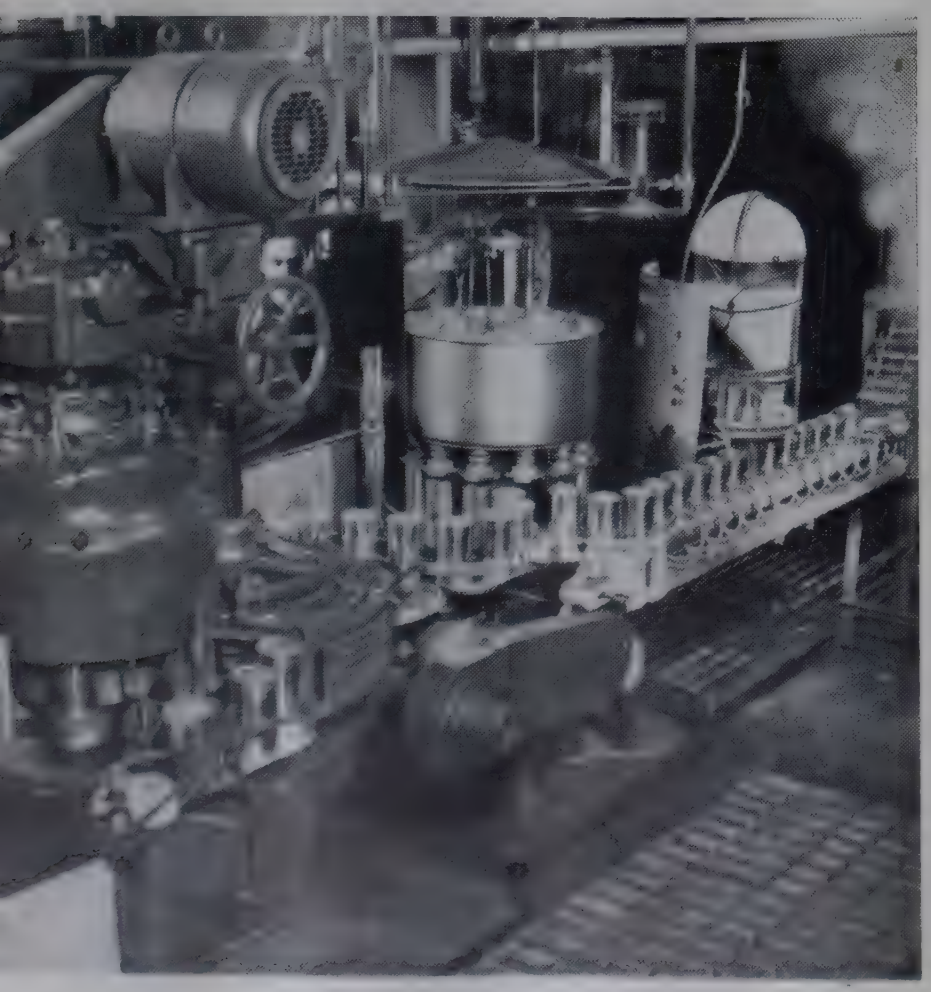


presentative types of tin container sizes as taken from list page 4. Sizes shown (lf. to rt.): 8Z tall, No. 1 picnic, No 1 tall, No. 303, No. 2½, and No. 10. Top row shows each size with double seam, bottom row with different inside enamel.

es. Plain water is usually added to lower grades of fruits d vegetables. Salt brine usually is of two per cent concen- ation and made from relatively pure salt and clean, soft ater. Sugar syrups vary in concentration with the sweetness the raw fruit and the grade of the raw material used. The ncentrations vary from 10 to 60 per cent sugar and are ade from clean, soft water and beet or cane sugar or a ixture of corn sugar and beet or cane sugar.

EXHAUSTING:—Objective of this step is to obtain a vac- um within the container. The purpose of the vacuum is to aid holding the cover on glass containers, draw in the ends of n containers, minimize the corrosive action of the contents

juice canning line in California showing left to right: clos- g machine, filler, dispenser using dry salt and can washer.



on the container, dispel included air and other gases, and prevent unnecessary strain on the containers during sterilization. A vacuum is obtained by heating the food material before filling into the can or heating the food in the can prior to sealing, by mechanical pump evacuation, or by steam injected directly into the headspace.

CLOSING (sealing):—Objective of this step is to obtain an airtight seal between the cover and the body of the container so that spoilage agents cannot enter the sealed container after the contents have been sterilized. Closing of both tin and glass containers is usually accomplished with mechanical equipment.

PROCESSING (cooking):—Objective of this step is to apply heat to the container and its contents at a temperature and for a length of time sufficient to kill or inactivate potential spoilage agents without overcooking the food. Processing is accomplished by placing the containers and contents in boiling water, by pressurized steam in a closed vessel or by water heated with pressurized steam in a closed vessel. The closed vessels used for processing under pressure are called retorts. Fruits are usually processed in boiling water (212° F.). Vegetables, meats, and poultry should be processed at temperatures higher than that obtainable by boiling water. Vegetables, meats, and poultry when canned in tin containers may be processed in pressurized steam in a closed vessel (240° F. or higher) or in water heated by pressurized steam in a closed vessel (240° F. or higher). All foods in glass containers, with metal tops, are usually processed in water heated to the desired temperature with pressurized steam in a closed vessel which has air under pressure added to the vessel to keep the metal cap on the container.

Processing times and temperatures required for each food depend on:

1. **The type and number of spoilage agents in or on the product at the time of canning.** Molds, yeasts, and some types of bacteria are killed or inactivated at 212° F. while other bacteria require temperatures higher than 212° F. Foods which have a large number of spoilage agents present require high temperatures for extended periods of time for adequate processing.
2. **The consistency of the product.** Solid packs and thick

liquids require longer periods of processing than loose packs and thin liquids.

8. **The acidity of the product.** Most spoilage agents are less resistant to heat in the presence of acids and, usually, the more acid the product the less processing is required.

COOLING:—Objective of this step is the rapid removal of heat from the canned food after processing to prevent overcooking. Also, rapid cooling of the canned food tends to inhibit the growth of any spoilage agents that may not have been killed by the processing period. Cooling is usually accomplished by a cold water bath or spray or by cool air. Cold water bath or spray cooling are the more desirable methods of cooling as they are more rapid. Tin containers should be cooled to just above room temperature before removing from the cooling water. The slightly warm cans will evaporate any water remaining on the cans and rusting will be prevented.

STORING (warehousing):—Objective of this step is to hold the canned product under conditions that do not alter the quality of the food or the appearance of the container until the food is shipped. Storage should be at cool temperatures because high temperatures of storage result in color changes and off flavor development. Alternate freezing and thawing of canned foods results in softening of the texture. High humidities in warehouses may result in rusting of the outside of the container which becomes unsightly. Rusting may also cause pinholing of the can and subsequent spoilage.

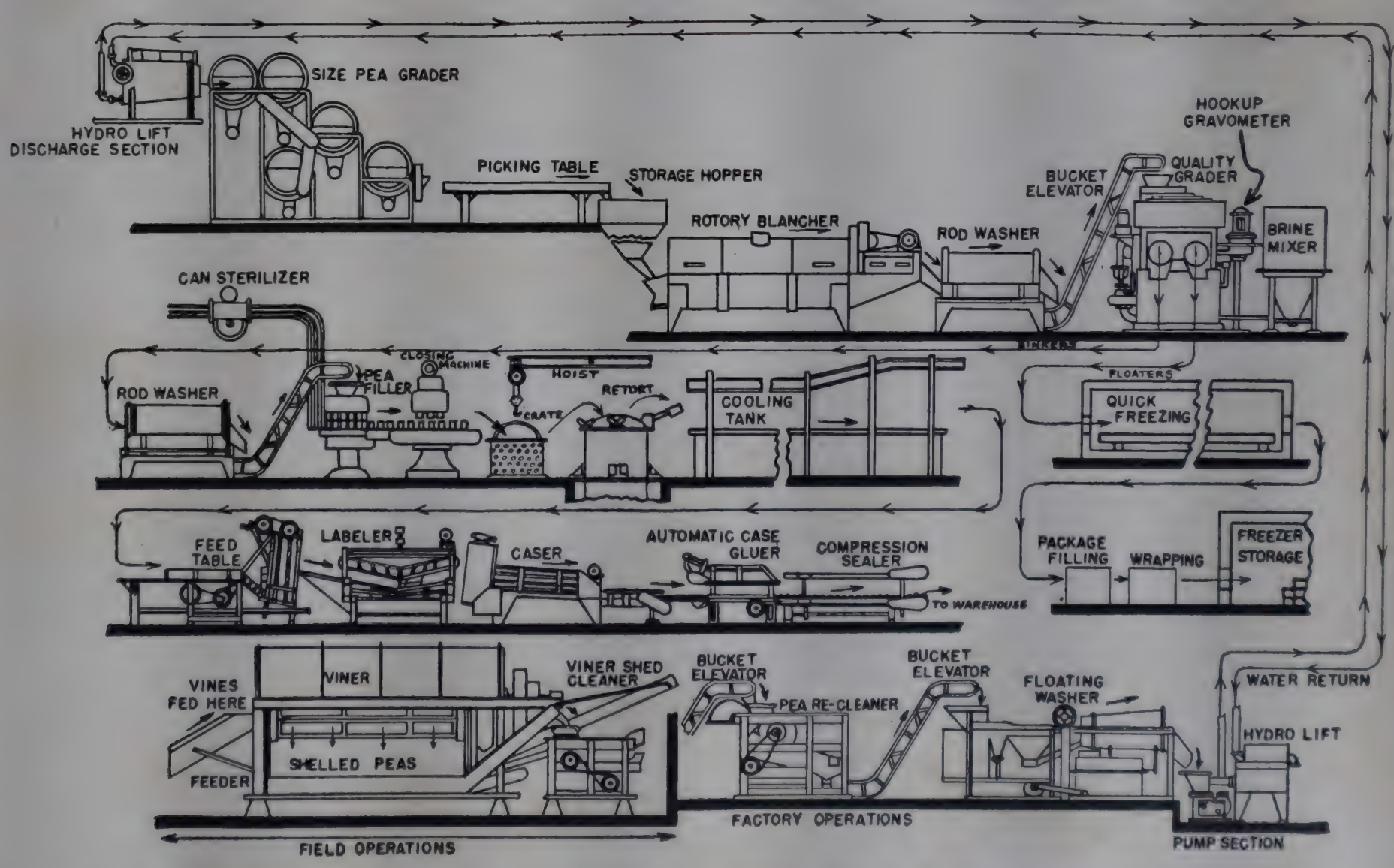
Selection of Materials and Cannery Location

The location of a canning plant depends on several general factors and these factors are so interrelated that they must be considered as a whole before selecting the site for a factory. The plant should be located where the raw foods of the desired quality, quantity, and price are available. Reasonably priced transportation for raw materials and finished products should be readily accessible. The factory should be adequate in size to handle the volume of business planned. Power, water supply, and the sewage system should be of the type and size to perform their necessary functions. The equipment and plant should be so designed to provide for optimum efficiency and the most desirable sanitary conditions. An adequate and competent labor supply should be available.

The quality of a canned product is no better than the quality of the raw material used, therefore, care in selection of the original material to be used is important. The raw food material should be canned as soon after harvesting as possible so that great changes in flavor, color, and texture do not occur between time of harvesting and time of canning. Cultural practices and procedures should be controlled to the extent that a continuous flow of raw material is available to the canner throughout the growing season.

Equipment designers and manufacturers have produced machines to do most every job in a canning plant. However, only such equipment that will do the work properly and has the necessary capacity should be installed. The whole canning plant should be so planned to synchronize the equipment and hand work and to eliminate delays in the canning procedure. The equipment used should be so designed that repairs may be easily made and all parts in contact with the food or the container may be thoroughly cleaned.

Tin containers are made from sheets of steel covered with a thin layer of tin. There are several methods of coating the sheets of steel with tin and the finished cans from each method are intended for specialized uses. The supplier of cans will recommend the proper type of container for a particular product. Tin containers having the inside coated with a special enamel are used on some foods. One type of enamel, Sanitary or Standard Enamel, is used for red colored fruits and vegetables. This enamel prevents color fading which may occur when the red colored fruits or vegetables are in contact with plain tin. Another enamel, C-Enamel, is used for foods that contain sulfur, as in the case of corn and baked beans. Sulfur reacts with plain tin to form a harmless but



Flow sheet diagram of a general pea canning and freezing line. Copyright by Chisholm-Ryder Co.

Representative types of glass container sizes as taken from list on page 5. Sizes shown (lf. to rt.): first row, 29-16, 10-51, 26-48 and 15-53; second row, 16-53, 11-76, 28-72, 20-75 and 22-51; third row, 52-33, 58-39, 59-38, 58-38, 59-39 and 50-51.

insightly black discoloration on the food. Other types of enamels are used for special foods such as citrus juices, wine, beer, soups, and meats.

Commercial canneries that use glass containers usually use the type of jar that has a metal cap. The cap is held tightly onto the jar due to vacuum within the container. An air-tight seal is maintained by a sealing compound on the inside of the cover at the point of contact with the jar rim. The metal caps may be enameled for the same reasons that apply to the enameling of tin containers. Glass does not react with most foods and therefore inside enamels are not needed. Glass containers are sometimes tinted brown or green in color for food products that may change color when stored or displayed in direct sunlight.

Usually liquids are sold by liquid measure. Therefore, narrow neck bottles are generally made to hold a certain amount of liquid. Semi-solids, as a rule, are sold by weight. Consequently, jar sizes were developed to hold the net weight of the contents, such as 1 lb. of preserves, 1 lb. of peanut butter, 1½ lbs. apple butter, etc. There are exceptions, such as mayonnaise, a semi-solid which is sold by liquid measure (pint, quart, etc.). Some jars and a few bottles were designed to correspond to cans. These were not designed to hold a specific volume of liquid by liquid measure, nor a specific weight of product by avoirdupois measurement.

All glass containers do not hold the same volume even though designed to hold a specific measurement. This is due to varying headspace requirements. For instance, if vinegar is bottled by one glass packer at a high temperature, that bottle requires greater headspace than if the vinegar were bottled at a lower temperature. In such a case the vinegar contracts more than at a lower temperature. However, the bottle must still hold a pint of the product at room temperatures.

COMMON CAN SIZES

Can Name	Dimensions Diameter	Dimensions Height	Canner's Designation	Approximate Net Weight	Net Contents Liquid Products
8Z	2-1/8"	3-1/2"	202x308	5-3/4 oz.	.....
8Z Tall	2-11/16"	3-1/4"	211x304	8-1/2 oz.	7-3/4 fl. oz.
No. 1 Picnic	2-11/16"	4"	211x400	10-1/2 oz.	9-1/2 fl. oz.
No. 211 Cylinder	2-11/16"	4-7/8"	211x414	.....	12 fl. oz.
No. 300	3"	4-7/16"	300x407	14-1/2 oz.	13-1/2 fl. oz.
No. 1 Tall	3-1/16"	4-11/16"	301x411	1 lb.	15 fl. oz.
No. 303	3-1/16"	4-3/8"	303x406	1 lb.	15 fl. oz.
No. 303 Cylinder	3-3/16"	5-9/16"	303x509	1 lb. 5 oz.	1 pt. 3 fl. oz.
No. 2 Vacuum	3-7/16"	3-3/8"	307x306	12 oz.	14 fl. oz.
No. 2	3-7/16"	4-9/16"	307x409	1 lb. 4 oz.	1 pt. 2 fl. oz.
No. 2 Cylinder	3-7/16"	5-3/4"	307x512	1 lb. 9 oz.	1 pt. 7 fl. oz.
No. 2½	4-1/16"	4-11/16"	401x411	1 lb. 13 oz.	1 pt. 10 fl. oz.
No. 3 Cylinder	4-1/4"	7"	404x700	.....	1 qt. 14 fl. oz.
No. 5	5-1/4"	5-5/8"	502x510	3 lbs. 9 oz.	1 qt. 1 pt. 4 fl. oz.
No. 10	6-3/16"	7"	603x700	6 lbs. 10 oz.	3 qts.

GLASS CONTAINER SIZES:—In cooperation with the Glass Container Manufacturers Institute, the following table on certain glass container sizes has been compiled. The number preceding the dash in the GCMI Item No. denotes the series number. The number following the dash is assigned for the purpose of identifying the container by size. While manufacturers frequently use their own numbering systems to identify their own glass containers, the GCMI identification symbols are familar to the trade and readily recognized. Series 10 denotes the plain round jars, series 11 the quart jar, series 12 the large size jar, series 20 the wide mouth jar, series 21 the syrup jar, series 24 wide mouth gallon jar, series 15 & 16 fruit and vegetable jar, series 22 fancy wide mouth oval jar, series 26 wide mouth peanut butter jar,

series 28 wide mouth bead type peanut butter jar, series 29 baby food jar, series 50 round food line bottle with short neck, series 52 chili sauce bottle, series 58 small neck catsup bottle, and series 59 large neck catsup bottle.

COMMON GLASS SIZES

GCMI Item No.	Overflow Capacity Fl. Oz.	Wt. of Jar Ozs.	Dimensions Height	Dimensions Diameter	Uses
10-14	4¼	3¾	3 25/64	2 3/32	Products requiring 4 oz. capacity (mayonnaise)
10-24	7¾	4¾	4⅛	2⅜	½ lb. peanut butter
10-28	8¾	5¾	4 11/32	2 17/32	Products requiring ½ pint capacity (mayonnaise, relish), 9 oz. mustard
10-30	9½	6	4 31/64	2 37/64	¾ lb. preserves
10-39	12½	6½	4 27/32	2 29/32	For placed olives, 1 lb. jam, 12 oz. pickles
10-48	15½	7⅞	5⅛	3 1/16	1 lb. peanut butter, mustard—1 lb. 2 oz. relish
10-51	16½	8	5 7/32	3 5/32	1 pint capacity (mayonnaise, pickle relishes, edible oils)—1 lb. mustard
10-63	24½	10⅝	5 61/64	3 37/64	2 lb. preserves, 1 pt. 8 oz. pickles, 28 oz. apple butter
10-72	31	12¼	6 9/16	3 53/64	2 lb. peanut butter, mustard
10-75	32⅝	12½	6¾	3 55/64	1 quart capacity (salad dressing, pickles)
10-81	48¾	19	7 11/16	4 27/64	4 lb. jam, 1 qt. 1 pt. pickles
11-76	32⅝	12½	7 9/64	3 43/64	1 quart capacity (mayonnaise, pickles)
12-86	65¼	25	8⅜	4 55/64	½ gallon capacity (pickles)
12-96	130½	42	10 1/16	6 19/64	1 gallon capacity (pickles, mayonnaise, mustard)
20-51	16½	8½	5 3/64	3 7/32	same as 10-51
20-75	32⅝	12½	7 1/16	3¾	same as 10-75
21-85	58½	20	7 15/32	5 1/32	5 lb. syrup
22-26	8⅜	6¼	4 25/32	2 41/64	½ pint salad dressing, ½ lb. mustard
22-40	12½	8¼	5 25/64	3 7/64	1 lb. preserves
22-48	15½	9½	5 55/64	3 17/64	1 lb peanut butter
22-51	16½	10	6	3 11/32	1 pint salad dressing, pickles, relishes, 1 lb. mustard
22-63	24½	12⅝	6¾	3 51/64	2 lb. preserves
22-75	32⅝	14½	7½	4 5/64	1 qt. mayonnaise, edible oils, 1 qt. pickles, 2 lb. mustard
24-96	130½	41	9 55/64	6 5/16	same as 12-96
26-24	7¾	5½	3 33/64	2 19/32	½ lb. peanut butter
26-48	15½	8¾	4	3 11/32	1 lb. peanut butter
28-60	22¾	10½	5½	3 29/64	1½ lbs. peanut butter
29-16	5	3 7/16	3 17/32	2 3/32	Approximately 4¾ oz. baby food
29-25	8.2	4 15/16	3⅞	2 33/64	Approximately 7¾ oz. baby food
50-08	2¼	3	4 3/32	1 37/64	2 fl. oz. various liquids
50-28	8¾	6½	5 31/32	2 13/32	8 fl. oz. liquids, ½ pint French dressing
50-40	12¾	8½	6 49/64	2 11/16	12 fl. oz. liquids, 1 lb. syrup
50-51	16⅞	10½	7⅜	2 61/64	16 fl. oz. vinegar, apple juice, 1½ lb. syrup
50-64	25⅜	14	8⅜	3 11/32	24 fl. oz. liquids, 2 lbs. syrup
50-76	33 7/16	17	9 5/16	3 39/64	1 quart vinegar
52-33	10¼	9¼	7	2 29/64	12 oz. Chili Sauce
50-19	105⅝	37	10 5/32	6 5/64	Corresponds to No. 10 can

CATSUP BOTTLE

* Overall height shown applies to bottles supplied with Glass Finish No. 27-1720 or 32-1720. Overall height is ⅛" greater when Glass Finish No. 26-250 or 31-250 is supplied.

GCMI Item No.	Overflow Capacity Fl. Ozs.	Wt. of Jar Ozs.	No. of Panels	Dimensions Height	Dimensions Diameter	Suggested Uses
58-22	7⅛	7¼	8	7	2 7/32	8 oz. catsup
58-38	12¼	10¼	8	8¼	2 39/64	14 oz. catsup
58-39	12¼	10¼	16	8¼	2 19/32	14 oz. catsup
59-38	12 1/16	10¼	8	8¼	2 37/64	14 oz. catsup
59-39	12 1/16	10¼	16	8¼	2 35/64	14 oz. catsup

FRUIT AND VEGETABLE JAR

15-53	17	7¼	Shoulder	4 11/16	3¼	Corresponds to No. 303 can **
15-71	28⅜	11¼	Shoulder	4⅞	4 3/32	Corresponds to No. 2½ can **
16-53	17	8½	Bead	5 19/64	3 7/64	same as 15-53 **
16-71	28⅜	13½	Bead	6 11/32	3 47/64	same as 15-71 **

** Weight of contents varies according to product packed.

Chapter II—Canning of Fruits*

APPLES (Pyrus Malus)

FRUIT used for canning purposes should be firm, sound, with slight acidity, good flavor, and should cook well. In many plants the apples are handled in baskets or boxes after being received, rather than using conveyors so as to prevent bruising as much as possible.

Apples from orchards that have used the arsenic sprays are washed in a dilute hydrochloric acid and then rinsed with water so as to remove the arsenic and acid. Some plants utilize the peelings, cores, and cull apples, either for cider (which is later converted into vinegar) or else for making jelly. In other cases they are dried and sold. The apples should be washed to remove dirt and debris even if they have not been sprayed. This will remove yeast, mold, and bacteria, and lessen the possibility of spoilage during storage.

Where the peelings are to be utilized, care should be taken to lessen metallic contamination such as iron and copper salts. Iron may later give an off taste and black color and copper give an astringent off taste. Do not use iron or galvanized vessels, chutes or troughs because the zinc will easily wear off, leaving the iron exposed which is easily attacked and dissolved and subsequently producing discolored jelly, apple butter, etc.

Usually the fruit is sorted for quality and size by running over a sorting machine. Any sound culls or windfalls may be used if they are not bruised or broken too badly, but their use means more labor for trimming and greater loss of fruit.

The fruit is transported to the operators either by conveyor belts or carried in boxes and baskets and dumped into tapering hoppers. Where apples are received by car loads, they are often unloaded directly onto conveyors and transported to the operators. They should be handled carefully to prevent bruising.

Operators place the apples on the peeling machines, from thence they are conveyed to a tank of dilute salt brine (about 15 pounds of salt per 100 gallons of water) to prevent discoloration where they remain for about 8 minutes or as long as may be necessary. Unless kept under water, they will turn brown due to an enzyme which aids oxidation. After passing through the salt brine, they are conveyed to roller conveyors or inspection belts where the apples are inspected, and bruised as well as improperly peeled ones are removed and trimmed. The apples then are conveyed to the seedcell-slicing machines, where they are sliced into segments 4, 8, 12, or 16 slices and then on to a revolving screen, which removes small particles of apples. The apples are either conveyed or dumped into a tank of water where they are washed and held until ready for filling. It is better to deliver the apples from the slicers directly into the tank of water rather than collect the slices in boxes because the quicker the apples are handled and covered with water, the better the color.

PINHOLING:—Apples can cause heavy losses to packers due to pinholing and swells. It was thought the trouble was due to light or defective plate used, but tests have demonstrated that the trouble was due to the action of the fruit acid in the presence of oxygen (air). Apples are somewhat porous, containing in addition to oxygen, carbon dioxide and nitrogen in varying amounts. These gases are driven out of the fruit when it is processed, the water used in covering the fruit replacing them. This allows an air space at the top of the can which contains the gases and later causes pinholing. In order to remedy this trouble the fruit can be handled several ways:

Vacuum Method:—Place the cut fruit in special retort baskets that have been lined with any material which prevents the discoloration of the fruit due to contact with the iron. Then place a rack on top of the apples to prevent floating and lower the filled baskets into warm water in the retort (about 120° F.). The air is removed from the closed retort with a vacuum pump maintained at 20 inches for 10 minutes, then fill the apples into cans or glass containers, add hot water, seal and process.

Hot Water Method:—The prepared fruit is submerged in warm water at 120° F. for about 30 minutes; this drives off the other gases and the water fills the space occupied by them. Fill into cans or glass containers and cover with hot water. Exhaust 3 to 4 minutes, seal and process.

Steaming:—The prepared fruit may be steamed either on racks or in a continuous steam blancher for about six minutes at about 180° F.; the temperature and time depend upon the fruit. Steaming wilts the apples and permits the proper weight to be packed. The apples may then be packed in containers, which are placed in retorts under live steam for a short time to remove the gases, or packed solidly, a small amount of water added, sealed, and sterilized.

Apples may be either water or solid packed with the addition of very little if any water. Solid pack apples require more blanching or exhausting in order to get the proper weight into the can. Solid pack apples should be packed as hot as possible and given a longer exhaust so that the heat can penetrate. More apples can be filled into a can by the solid pack method—often 96 to 112 ounces of steamed apples can be packed into No. 10 tins, than when packed in water as only 72 ounces can be packed in No. 10 tins.

Wet Pack

Size of Containers	Exhaust	Cook
2½	3 min. in steam	7 min. at 212° F.
3	3 min. in steam	7 min. at 212° F.
10	3-4 min. in steam	8-10 min. at 212° F.

Solid Pack

Size of Containers	Exhaust	Cook
2½	4-5 min. in steam	15 min. at 212° F.
3	4-5 min. in steam	15 min. at 212° F.
10	8 min. in steam	20-30 min. at 212° F.

For ten's the apples should be filled at a temperature between 150 and 160° F.

These periods of time may be materially decreased if the apples have been prepared by the second method. Cool to prevent discoloration.

FILLING:—Place as many apples in the metal or glass container as possible by means of shaking or using a plunger. However, when steamed properly to make the pieces flexible, the weight can be easily packed into the containers. There are automatic machines which fill very efficiently.

CANS:—Plain unenameled cans as recommended by the

*Information relating to type, styes, drained weights, counts, and sizes for each commodity is from the latest standards of the Production and Marketing Administration, United States Department of Agriculture.

container supplier should be used for packing apples to avoid pin-holing and hydrogen swells.

Styles of Canned Apples

Sliced canned apples are segments of apples that are obtained by cutting the apples longitudinally.

Suggested Label Weights (Net Weight)

Apples (Sp. Gr. .95)		Lbs.	Ozs.
No. 2	307x409	1	2
No. 2½	401x411	1	10
No. 10	603x700	5	15
No. 10 solid pack*		6	.

Drained Weight—(heavy pack)—Canned apples that meet the following drained weight requirements are certified as to the grade to which they conform with the additional statement "Heavy Pack." No. 2—18 ozs.; No. 2½—26 ozs.; No. 10—96 ozs.

APPLE SAUCE:—In making sauce usually cull apples that are tart but too small for paring are used. Apples that are "flat" and "insipid" should not be used, for tart ones produce a better sauce.

PREPARING PULP:—The more rapidly the fruit is handled, cooked and canned, the better the color and flavor. Too high and too long a cook may cause discoloration and often caramelization.

Wash the apples before using.

Some processors make sauce from peeled apples, but this method only increases the cost. If peeled apples are used, the usual precautions to prevent discoloration by holding in a dilute salt brine should be adhered to. Rinse the apples to remove the salt before cooking.

The fruit should be either cooked under pressure for a short time to disintegrate the apples, or else steamed to loosen the skin and soften the pulp, then passed through a pulper to remove seeds, skins, and seed pods, and then cooked under vacuum to keep the color light. The vacuum process produces a light-colored product that is desirable in sauce. Fill into containers hot, cap, and process for eight to ten minutes. The pulp should be cooked about 10 to 15 minutes to remove excess water. Sugar may be added, depending upon the tartness of the apples. Usually from 10 to 15 pounds of sugar are added for each 50 pounds of pulp. Spice may be added if desired. When peeled apples are used the peelings and cores may be utilized for making jelly or vinegar. If preferred, the apples may be run through an apple grater and given a light cook and then through a finisher using a screen with 0.033 inch perforation and if coarse pulp is desired use a screen with 0.05 inch perforation to remove the seeds, skins, etc.

In spicing, a small amount of powdered spice such as cinnamon, allspice, or nutmeg may be used, about one ounce of each per 200 pounds of sauce. Mix the spices with a small amount of cold water so they will not lump. Then add to batch a very short time before the cooking is completed. Allspice has a tendency to cause a dark surface which can be avoided by using oil of pimento.

FILLING AND PROCESSING:—Fill sauce into cans or glass as near boiling as possible, leaving very little if any "head space" at the top. It is not necessary to pass the filled containers through an exhaust box if the sauce is hot when filled.

CANS:—Use only plain unenameled cans made from charcoal 2-A plate to prevent pinholing and hydrogen swells.

DISCOLORATION:—May be caused by apples standing around after being trimmed, due to oxidation or due to metallic contamination from iron equipment which unites with the oxygen and tannin present in the apples, or due to too high a temperature used in cooking, or due to open kettle cooking or improper cooling after processing, or stacking when too hot.

To prevent bruising, apples come from the orchard in hampers or boxes. A trolley conveyor carries hampers to cleaners.

PROCESSING:—No. 2 cans at 212° F. for 12 minutes, No. 10 tins at 212° F. for 20 minutes.

Some do not process if the product is filled near the boiling point but for safety sake it should be processed.

Cool quickly to prevent further cooking or caramelization. In glass jars if a watery separation should occur, heat to about 150° F. and shake to mix thoroughly.

Baked Apples

All apples should be thoroughly washed to remove spray residues before attempting to pack. They should all be of uniform shape for the size container to be used. Core through the blossom end but do not remove the stem. Bake well in ovens and pack into the proper size container and cover with heavy hot syrup of at least 40° Brix. Then process six to eight minutes at 212° F. for No. 3 container and other sizes in proportion. Some wrap the baked apples in parchment paper

After a good wash, apples are quickly cored and peeled to prevent discoloration on a production line of paring machines.

r place in individual parchment paper dishes before placing
n containers for processing.

Suggested Label Weights (Net Weight)

Apple Sauce (Sp. Gr. 1.07)		Lbs.	Ozs.
8Z Tall	211x304	.	8½
No. 1 Tall	301x411	1	.
No. 303	303x406	1	.
No. 2	307x409	1	4
No. 2½	401x411	1	13
No. 10	603x700	6	12

APRICOTS (Prunus Armeniaca)

Most apricots in the United States are packed in California where they grow abundantly. The fruit must be ripened on the tree to obtain the proper flavor, as unripe fruit has an astrigent, bitter taste. Yet, if permitted to remain on the tree until too ripe, they will not stand the necessary processing temperature. Apricots are decidedly acid, so that it is necessary to add more sugar in canning than is required for most other fruits. They are packed in a 55° Brix syrup for fancy, 40° Brix for choice, 25° for standard, and 10° for seconds.

On account of their softness, the fruit is not usually peeled, but halved, and the pit removed after being sorted for size by passing over a mechanical grader.

The pitted fruit is packed by hand in order to select fruit of uniform size, color, and ripeness.

EXHAUST AND PROCESS:—Apricots like apples contain some gas which must be eliminated before fruit is sealed, in order to prevent pinholing. As this fruit will not stand the severe treatment accorded apples, the contents of the container are given a long exhaust.

Size of Container	Exhaust	Process
No. 1	5 minutes	8 minutes at 212° F.
No. 2½	6½ minutes	10 to 12 minutes at 212° F.
No. 10	10 minutes	40 minutes at 212° F.

For ten's, the time is the same for in syrup, pie grade and bakers grade.

If continuous agitator cooker is used, the time can be reduced.

By gradually cooling containers, the color is intensified; whereas, when cooled rapidly, there is a tendency to bleach.

The following is the standard adopted by the Canner's League of California for the number of pieces per can:

Apricots	8Z Tall	No. 1 Tall	No. 2	No. 2½	No. 10
Halves Unpeeled					
Fancy	10	16	19	24	86
Choice	12	20	24	30	108
Standard	15	26	31	42	151
Halves Peeled					
Approximately 10% more than Halves Unpeeled					
Whole Unpeeled					
Fancy	4	8	10	14	53
Choice	5	9	11	16	60
Standard	6	11	14	20	75
Whole Peeled					
Fancy	5	9	11	16	60
Choice	5	10	12	18	67
Standard	6	12	16	22	82
Halves Peeled and Unpeeled					
Fancy	3	4	5	6	21
Choice	3	5	6	7	25
Standard	4	6	7	8	29
Whole Peeled and Unpeeled					
Fancy	2	3	3	4	14
Choice	2	3	4	5	18
Standard	3	4	5	6	22

Styles of Canned Apricots

Halved canned apricots are peeled or unpeeled, pitted apricots, cut approximately in half along the suture from stem to apex.

Whole canned apricots are whole, peeled or unpeeled, unpitted apricots. The fruit may be slit along or through the suture.

Suggested Label Weights (Net Weight)

Apricots		Lbs.	Ozs.
Fancy (Sp. Gr. 1.10)			
8Z Tall	211 x 304	.	8¾
No. 1 Tall	301 x 411	1	1
No. 2	307 x 409	1	5
No. 2½	401 x 411	1	14
No. 10	603 x 700	6	14
Choice (Sp. Gr. 1.08)			
8Z Tall	211 x 304	.	8¾
No. 1 Tall	301 x 411	1	.
No. 2	307 x 409	1	4
No. 2½	401 x 411	1	14
No. 10	603 x 700	6	12
Standard (Sp. Gr. 1.06)			
No. 1 Tall	301 x 411	1	.
No. 2	307 x 409	1	4
No. 2½	401 x 411	1	13
No. 10	603 x 700	6	10
Seconds			
No. 2½	401 x 411	1	12
Water (Sp. Gr. 1.03)			
No. 2½	401 x 411	1	12
No. 10	603 x 700	6	7
Pie			
No. 10	603 x 700	6	8
No. 10 solid pack		6	10

Recommended Minimum Drained Weights—Apricots

Container size or Name	Minimum Drained Weight (in ounces) Metal Containers Halved	Metal Containers Whole	Glass Containers Halved	Glass Containers Whole
8 Z Tall	5¼	5	..	..
No. 1 Tall	10	9½	..	..
No. 2	12½	12	..	..
No. 2½	18	17	17	16
No. 2½ (Solid-Pack)	25½	..	..	..
No. 10 (Grades A, B, C, D, and E, in any syrup and "water slightly sweetened")	66	63	..	..
No. 10 (Grades A,B, C, "water pack")	66	63	..	..
No. 10 (Grades D and E "water pack"	76	72	..	..
No. 10 (Solid-Pack)	92	92	..	..

SYRUP DENSITY:—"Extra heavy syrup" means that the syrup tests 25° or more, but not more than 40° Brix.

"Heavy syrup" means that the syrup tests 21° to 25° Brix.

"Light syrup" means that the syrup tests 16° to 21° Brix.

"Water, slightly sweetened" means that syrup tests less than 16° Brix.

"Water pack" means that the product is packed in water.

The container shall be filled with apricots as full as practicable without impairment of quality. The product and packing medium occupies not less than 90% of the volume capacity of the container.

Drained weights of canned apricots are determined by emptying the contents of the container upon a circular sieve of proper diameter, containing 8 meshes to the inch (0.997-

inch perforations) and allowing to drain for 2 minutes. A sieve 8 inches in diameter is used for No. 2-½ size containers and smaller, and a sieve 12 inches in diameter is used for containers larger than No. 2-½ size.

Units that are blemished with "freckles," scab, hail injury, discoloration, or other abnormalities are considered under the classification of possessing "minor" or "major" defects.

"Minor" defects are surface blemishes that exceed in the aggregate, singly or in combination on a unit, the area of a circle ⅛ inch in diameter but do not exceed in the aggregate the area of a circle ¼ inch in diameter. Surface blemishes that in the aggregate are less than the area of a circle ⅛ inch in diameter and are lighter than dark brown and are otherwise insignificant are not considered as defects.

"Major" defects are surface blemishes that exceed in the aggregate, singly or in combination on a unit, the area of a circle ¼ inch in diameter. Units that possess blemishes that extend into the fruit, worm holes, serious insect damage, dark bruises, or spots which are dark brown or are black resulting from oxidation, improper processing, or other causes, are considered as units possessing "major" defects, regardless of the area of the injury.

"Crushed or broken units" are units that have been crushed or broken to the extent that they have lost their normal shape. Apricots which have lost their normal shape because of ripeness and which bear no mark of crushing are not considered crushed or broken units. Apricot halves that are slightly split from the outer edge to the pit cavity are not considered broken unless the units are not of normal shape. Whole apricots that are split along the suture are not considered broken units.

"Loose pits" are pits separated from any of the whole apricots in the container. When apricot pits (except in the case of whole apricots) have been added as a seasoning ingredient, there may be not more than one apricot pit to each 8 ounces of finished canned apricots.

Apricot kernels may be used as a seasoning ingredient in canned apricots (except in the case of whole apricots and except when apricot pits as a seasoning ingredient are present).

BLACKBERRIES (Rubus Villosus)

This berry grows in most sections of the country and may be cultivated to produce larger and better fruit, yet in certain sections it grows abundantly in a wild state.

The fruit after being sorted may be washed by passing under sprays of water or placed in vats of running water where the leaves and debris are floated off while stirring gently so as not to break the fruit.

The berries are filled into lacquered cans or glass containers, covered with syrup and exhausted either at 180° F. for 10 to 12 minutes, or from 3 to 5 minutes at 210° F.

Process No. 1 cans for 13 minutes at 212° F.; No. 2's (20° Balling syrup), 12 minutes; (40° syrup) 14 minutes; (and 60° syrup) 15 minutes at 212° No. 2½ cans for 12 to 15 minutes at 212° F.

No. 10 cans for 25 minutes for syrup grade at 212° F.

No. 10 cans for 40 minutes for pie grade at 212° F.

HEAVY PACK BLACKBERRIES:—Are often packed in water in No. 10 cans in such a manner as to result in a drained weight in excess of 80 ounces. Therefore, if the blackberries are so packed and meet all the requirements for either U. S. Grade A, U. S. Grade B, or U. S. Grade C, the canned blackberries will be certified as of the grade to which they conform, with the additional statement, "Heavy Pack."

SYRUP DENSITY:—Grades A, B, C, D, of blackberries are usually packed in sugar syrup. At time of packing, syrup of 40° Brix density is used on U. S. Grade A canned blackberries; 30° Brix on U. S. Grade B canned blackberries; 20° Brix on U. S. Grade C canned blackberries; and 10° Brix on U. S. Grade D.

To determine the drained weight of blackberries, separate the fruit from liquid upon a circular sieve of proper diameter.

"Extra heavy syrup" means that syrup tests 24° or over Brix.

"Heavy syrup" means that syrup tests 19° to 24° Brix.

"Medium syrup" means that the syrup tests 14° to 19° Brix.

"Light syrup" means that the syrup tests 11° to 14° Brix.

"Water pack" means that the packing media tests less than 11° Brix.

Recommended Head Space and Drained Weights

Drained weights of canned blackberries are determined by emptying the contents of the can upon a circular-sieve of proper diameter containing 8 meshes to the inch (0.097-inch perforations), and allowing to drain for 2 minutes. The sieve diameters used are: 8 inches for No. 2 size cans and smaller, and 12 inches for No. 10 size cans.

The maximum head space and the minimum drained weight allowable in the cans commonly used in packing canned blackberries are shown in the following table. Filled containers meeting the drained weight requirements that have not been packed as full as possible without impairment of quality will be certified "Below Standard in Fill".

Container Size	Maximum Capacity in water at 68° F. (in ounces)	Maximum head space allowable (measured from top of double seam in 16ths of an in.)	Minimum drained weight (in ounces)
3¼ Buffet	8.68	7.6	4¾
No. 2	20.55	9.7	12
No. 10	109.43	13.6	65
No. 10 Water (Heavy pack)	109.43	13.6	80

Suggested Label Weights (Net Weight)

Blackberries		Lbs.	Ozs.
Fancy (Sp. Gr. 1.08)			
8Z Tall	211 x 304	.	8¾
No. 1 Tall	301 x 411	1	.
No. 303	303 x 406	1	.
No. 2	307 x 409	1	4
No. 2½	401 x 411	1	14
No. 10	603 x 700	6	12
Choice (Sp. Gr. 1.06)			
8Z Tall	211 x 304	.	8½
No. 1 Tall	301 x 411	1	.
No. 303	303 x 406	1	.
No. 2	307 x 409	1	4
No. 2½	401 x 411	1	13
No. 10	603 x 700	6	10

Standard (Sp. Gr. 1.05)			
8Z Tall	211 x 304	.	8½
No. 1 Tall	301 x 411	1	.
No. 303	303 x 406	1	.
No. 2	307 x 409	1	4
No. 2½	401 x 411	1	13
No. 10	603 x 700	6	9
Water (Sp. Gr. 1.03)			
No. 1 Tall	301 x 411	1	.
No. 303	303 x 406	1	.
No. 2	307 x 409	1	3
No. 2½	401 x 411	1	12
No. 10	603 x 700	6	7

BLUEBERRIES (Vaccinium Corymbosum, V. Pennsylvanicum)

Whortle berries or Huckleberries:—This small, firm, round berry is grown on sandy soil and in swamps. The swamp berry is called whortleberry. The berries are harvested by means of a scoop or rake quite similar to the one used in harvesting cranberries. The scoop is basket shaped with projection-like tines of a fork set closely together. The scoop is passed through the bushes which removes the berries, some leaves and twigs. They are cleaned by running through a fanning mill to remove twigs, leaves, stems, and green berries, after which they are washed in tubs of running water to float any other leaves, twigs or defective fruit.

The packers of this fruit have had a great deal of trouble, due to maggots and worms, but the United States Department of Agriculture has cooperated with the packer so ably that they have to a great extent been able to reduce this trouble. The wormy and defective fruit is partly eliminated by floating in water.

As the fruit is used mostly for bakers it is packed in No. 10 tins and No. 2 containers and covered with water or an 18° Brix syrup for table use but a 30° Brix syrup produces a superior article.

Size of Container	Exhaust	Process
No. 1	2 minutes	12 minutes at 212°
No. 2	3 minutes	14 minutes at 212°
No. 3	3 minutes	25 minutes at 212°
No. 10	4 minutes	25 to 30 minutes at 212°

SYRUP DENSITY:—Blueberries (huckleberries) are often packed in syrup. Syrup "cut-out" requirements, however, are not incorporated in the grades of the finished product since syrup, as such, is not a factor for the purpose of these grades.

Canned blueberries or canned huckleberries will be certified as to grade without regard to syrup density, but in each instance Federal inspection certificates will indicate the density of syrup found upon examination. When samples are officially drawn, the designation of syrup will be based upon the average syrup density of all containers examined, provided the range of variability is within the limits of good packing practice. For this purpose—

"Extra heavy syrup" means that the syrup tests 25° Brix, or over.

"Heavy syrup" means that the syrup tests 20° to 25° Brix.

"Light syrup" means that the syrup tests 15° to 20° Brix.

"Water, slightly sweetened" means that the syrup tests less than 15° Brix.

"Water pack" means that the product is packed in water.

Recommended Fill of Container and Drained Weight

The container shall be filled with blueberries or huckleberries as full as practicable without impairment of quality. The product and packing medium shall occupy not less than 90% of the volume capacity of the container.

Drained weights of canned blueberries or huckleberries are determined by emptying the contents of the container upon a circular sieve of proper diameter containing 8 meshes to the inch (0.097-inch perforations) and allowing to drain for 2 minutes. A sieve 8 inches in diameter is used for No. 2-½ containers and smaller, and a sieve 12 inches in diameter is used for containers larger than the No. 2-½ container.

Recommended Minimum Drained Weights—Blueberries

Container Size	Minimum drained weight
No. 2	12 ounces
No. 10	65 ounces

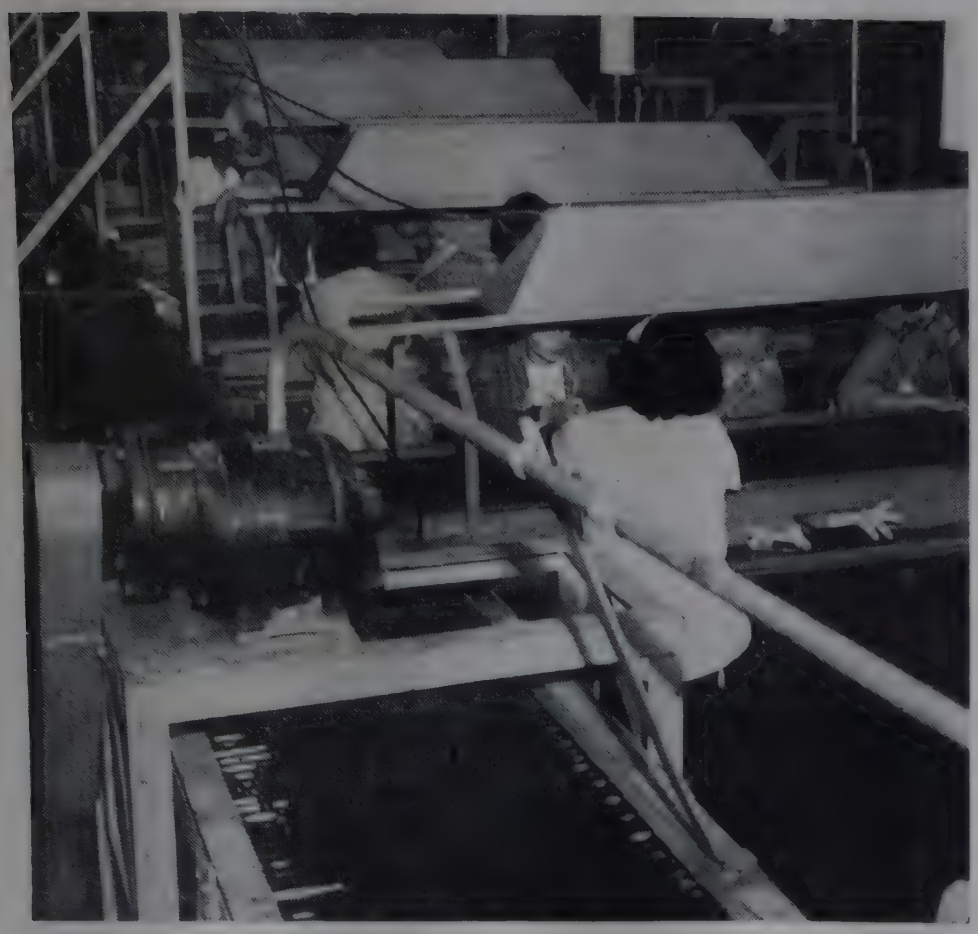
Suggested Label Weight (Net Weight)

Blueberries		Lbs.	Ozs.
40° Syrup (Sp. Gr. 1.05)			
No. 2	307 x 409	1	4
No. 10	603 x 700	6	9
Water (Sp. Gr. 1.02)			
No. 2	307 x 409	1	3
No. 10	603 x 700	6	6

CHERRIES (Prunus Cerasus)

SOUR CHERRIES:—Ripe fruit is packed in baskets, or boxes with stems attached to preserve the fruit during shipping and prevent growth of the yeast which develops quickly when the stems are removed. It is remarkable how rapidly yeast develops on the stemmed fruit shortly after picking. The stems and seeds can be removed by automatic machines. Some growers are delivering cherries to the factories without stems; consequently they begin to "bleed" as soon as picked. Fruit picked this way should be held in tanks of cold water until they are to be picked and seeded. Cold water will float off some of the defective fruit, loose stems, leaves, etc., chill the fruit and usually stop the fermentation. Holding in water will often bring the fruit back to its original plumpness so that pitting loss is smaller than if the fruit is pitted when received. Holding for too long a period will result in loss of flavor, color and give a generally unattractive appearance. Keep the cherries out of sunny or drafty places.

Unloading sour cherries just arrived from the orchard into a large steel tank holding cold water. This stops fermentation.



In this modern fruit processing plant, cherries are moved across a bar grader (foreground) before passing inspectors.

Cherries harvested at proper maturity are of good size for the particular variety, fairly firm, well colored and highly flavored. Immature cherries have a bitter tang.

The stemming machine consists of long, cylindrical rolls that revolve toward each other and are inclined so that as the cherries are fed onto them the stems are removed. The fruit is washed either by dipping into tubs of clean running water or by passing along an endless belt under sprays of fresh water. Washing by dipping the fruit in and out of the tank is not an effective means of cleaning the fruit, and should be discouraged. Sorting belts, well lighted, should be about 10 feet long and travel not over 20 feet per minute so that effective sorting can be done. The sorters should turn the cherries as they pass along.

The pitters are cylindrical with rows of cups on the circumference, and the cherries are fed to the cylinders one layer deep and one into each cup where the pit or stone is removed by a small plunger. The cups have small holes which permit the seeds to pass to the center of the cylinder and the fruit automatically drops out of the cup as the cylinder revolves.

All pitted fruit should be carefully inspected before canning or barrelling to see that all pits have been removed. It is well to pass the fruit along an endless belt where the pits can be easily removed. There is nothing that takes the joy out of cherry pie or preserves quicker than to bite on a cherry pit. Some fruit packers have not been properly pitting, and this condition reflects on the careful packer. Occasionally samples of pitted cherries should be taken from each pitting machine and examined for pits and when the pits run over 5 to a No. 10 can stop the pitter and correct the trouble.

The pits and juice may be collected and run through finishers to remove any pulp or juice which can be used in covering the cherries or for jelly, or place the pits in a kettle, cover with water and boil about ten minutes. Then strain through a cloth and use this juice to cover the fruit.

Fill 6½ pounds of pitted cherries into a No. 10 can, cover with warm water or cherry juice and process 25 to 30 minutes at 212° F. If a continuous rotary hot water cooker is used, the time can be reduced to 14 minutes at 212° F. and air cool. This size can is used by bakers. If the water used in filling is too hot, it may discolor the fruit. Use a hot water exhaust in preference to steam so the center of the can will be at least 180° F. Exhaust for about 10 minutes in water held at 200° F. After exhausting, seal and process immediately and cool until the heat of the can will just dry it and prevent dusting. Stack in a cool warehouse. These precautions will conserve the color.

No. 1 and 2 containers are for home consumption. For extra or heavy syrup goods, use 6 ounces of pitted cherries for a number 1 and 12 ounces for No. 2. Cover with 65° Brix syrup. For extra standard use 8 ounces of pitted cherries to a No. 1 and 16 ounces for a No. 2, covering with 50° Brix hot syrup. Process No. 1 can 12 minutes at 212° F. and No. 2 can 15 to 18 minutes at 212° F.

Recommended Drained Weight

The drained weight of canned red sour (tart) pitted cherries is determined by emptying the contents of the container upon a circular sieve of proper diameter containing 8 meshes to the inch (0.097-inch square openings) and allowing to drain for 2 minutes. A sieve 8 inches in diameter is used for No. 3 size cans (404 x 414) and smaller, and a sieve 12 inches in diameter is used for containers larger than the No. 3 size can.

Container Size or designation	Packed in water	Packed in any syrup or "slightly sweetened water"
No. 303	11 ounces	10¼ ounces
No. 2	13½ ounces	12¾ ounces
No. 10	74 ounces	70¼ ounces

SYRUP DENSITY:—"Extra heavy syrup" means that the syrup tests 28° or more but less than 45° Brix.

"Heavy syrup" means that the syrup tests 22° to 28° Brix.

"Light syrup" means that the syrup tests 18° to 22° Brix.

"Water slightly sweetened" means that the syrup tests less than 18° Brix.

"Water Pack" means that the product is packed in water, or any mixture of water and cherry juice.

Suggested Label Weights (Net Weight)

Cherries, Unpitted		Lbs.	Ozs.
Fancy (Sp. Gr. 1.10)			
8Z Tall	211 x 304	.	8¾
No. 1 Tall	301 x 411	1	1
No. 2	307 x 409	1	5
No. 2½	401 x 411	1	14
No. 10	603 x 700	6	14
Choice (Sp. Gr. 1.08)			
8Z Tall	211 x 304	.	8¾
No. 1 Tall	301 x 411	1	.
No. 2	307 x 409	1	4
No. 2½	401 x 411	1	14
No. 10	603 x 700	6	12
Standard (Sp. Gr. 1.06)			
8Z Tall	211 x 304	.	8½
No. 1 Tall	301 x 411	1	.
No. 2	307 x 409	1	4
No. 2½	401 x 411	1	13
No. 10	603 x 700	6	10
Seconds			
No. 2½	401 x 411	1	12
Water (Sp. Gr. 1.04)			
No. 2	307 x 409	1	4
No. 2½	401 x 411	1	12
No. 10	603 x 700	6	8
Cherries, Pitted			
Kettled (Sp. Gr. 1.20)			
No. 1 Tall	301 x 411	1	2
No. 303	303 x 406	1	2
No. 2	307 x 409	1	7
No. 2½	401 x 411	2	1
No. 10	603 x 700	7	8

Fancy (Sp. Gr. 1.10)			
No. 1 Tall	301 x 411	1	1
No. 303	303 x 406	1	1
No. 2	307 x 409	1	5
No. 2½	401 x 411	1	14
No. 10	603 x 700	6	14
Choice (Sp. Gr. 1.07)			
No. 1 Tall	301 x 411	1	.
No. 303	303 x 406	1	.
No. 2	307 x 409	1	4
No. 2½	401 x 411	1	13
No. 10	603 x 700	6	11
Standard (Sp. Gr. 1.05)			
No. 1 Tall	301 x 411	1	.
No. 303	303 x 406	1	.
No. 2	307 x 409	1	4
No. 2½	401 x 411	1	13
No. 10	603 x 700	6	9
Water (Sp. Gr. 1.03)			
No. 1 Tall	301 x 411	1	.
No. 303	303 x 406	1	.
No. 2	307 x 409	1	3
No. 2½	401 x 411	1	12
No. 10	603 x 700	6	7

SWEET CHERRIES:—Generally they are packed with the pits in order to give the product a better flavor. On account of the pit they require a longer process than is required for the pitted fruit, but they must not be given too much or the skin will burst and the fruit will be mushy.

Cover the fruit with a hot syrup (120° F.)—usually 40 to 50° Brix is used (although 50° syrup has a tendency to shrink the fruit), and give it about 10 minutes exhaust at 180° F. to permit the sugar to equalize and harden in order to toughen the skin; sterilize from 12 to 25 minutes depending upon the size of the container and quality of the fruit.

Styles of Canned Sweet Cherries

Pitted canned sweet cherries are stemmed cherries with pits removed.

Unpitted canned sweet cherries are whole stemmed cherries.

At time of packing, syrup of 40° Brix density is used on Grade A canned sweet cherries; 30° Brix on U. S. Grade B canned sweet cherries; 20° Brix on U. S. Grade C canned sweet cherries; and 10° Brix on U. S. Grade D. Syrup "cut-out" requirements, however, are not incorporated in Grades of the finished product as syrup as such is not a factor for the purpose of these grades.

Canned sweet cherries will be certified as to grade without regard to syrup density, but in each instance official certificates of grade will bear a notation in connection with the grade statement indicating the density of syrup found upon examination. For this purpose:

"Extra heavy syrup" means that the syrup tests 25° or over, Brix.

"Heavy syrup" means that the syrup tests 21° to 25° Brix.

"Medium syrup" means that the syrup tests 16° to 21° Brix.

"Light syrup" means that the syrup tests 12° to 16° Brix.

"Water Pack" means that the packing media tests less than 12° Brix.

Recommended Head Space and Drained Weights

Drained weights of canned sweet cherries are determined by emptying contents of the container upon a circular sieve of proper diameter containing 8 meshes to the inch (0.097-inch perforations), and allowing to drain for 2 minutes. The sieve diameters used are: 8 inches for No. 2½ size containers or smaller, and 12 inches for No. 10 size cans.

The maximum head space and the minimum drained weight allowable in containers commonly used in packing canned

Close-up of picking table in a cherry processing line. Woman inspectors must be trained to quickly detect spoiled fruit.

sweet cherries are shown in the following table. Filled containers meeting the drained weight requirements that have not been packed as full as possible without impairment of quality will be certified "Below Standard in Fill."

Container size	Maximum capacity in water at 68° F. (in ounces)	Maximum head space allowable (measured from top of double seam in 16ths of an inch)	Minimum drained weight (in ounces)
8Z Tall	8.68	7.6	5¼
No. 1 Tall	16.70	9.9	10½
No. 2	20.55	9.7	13
No. 2½	29.79	9.9	19
No. 10	109.43	13.6	70
No. 10 Water	109.43	13.6	73
No. 10 Heavy Pack-Pie	109.43	13.6	86

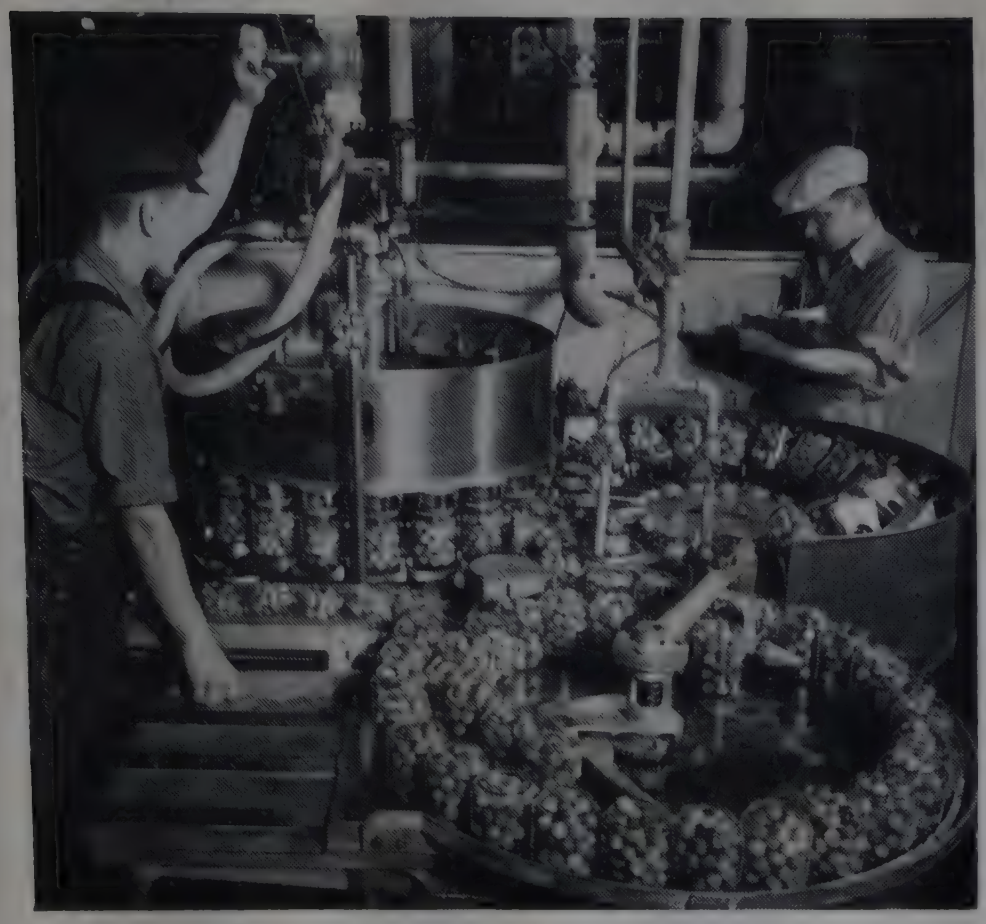
In determining compliance with the above drained weight requirements a 6 percent tolerance shall be allowed for sweet cherries packed in extra heavy syrup (testing over 25° Brix) and a 3 percent tolerance shall be allowed for sweet cherries packed in heavy syrup (testing over 21° Brix). In addition, if average drained weight of a sample container meets these requirements, the sample will invariably be certified.

COUNT:—Maximum number of sweet cherries per container and the maximum variation in the number of cherries per container shall correspond to the following table.

Container Size	U. S. GRADE A		U. S. GRADE B		U. S. GRADE C	
	Max.	Var/can	Max.	Var/can	Max.	Var/can
8Z Tall	33	6	41	8	50	16
No. 1 Tall	57	12	71	15	89	30
No. 2	67	14	83	17	106	35
No. 2½	85	16	105	20	145	40
No. 10	306	58	378	72	522	144

Suggested Label Weights (Net Weight)

Cherries, Unpitted			
Fancy (Sp. Gr. 1.10)			
8Z Tall	211 x 304	.	8¾
No. 1 Tall	301 x 411	1	1
No. 2	307 x 409	1	5



Jars of cherries being inverted to drain before passing through syruper, and then being conveyed to exhauster in background.

No. 2½	401 x 411	1	14
No. 10	603 x 700	6	14
Choice (Sp. Gr. 1.08)			
8Z Tall	211 x 304	.	8¾
No. 1 Tall	301 x 411	1	.
No. 2	307 x 409	1	4
No. 2½	401 x 411	1	14
No. 10	603 x 700	6	12
Standard (Sp. Gr. 1.06)			
8Z Tall	211 x 304	.	8½
No. 1 Tall	301 x 411	1	.
No. 2	307 x 409	1	4
No. 2½	401 x 411	1	13
No. 10	603 x 700	6	10
Seconds			
No. 2½	401 x 411	1	12
Water (Sp. Gr. 1.04)			
No. 2	307 x 409	1	4
No. 2½	401 x 411	1	12
No. 10	603 x 700	6	8
Cherries, Pitted			
Kettled (Sp. Gr. 1.20)			
No. 1 Tall	301 x 411	1	2
No. 303	303 x 406	1	2
No. 2	307 x 409	1	7
No. 2½	401 x 411	2	1
No. 10	603 x 700	7	8
Fancy (Sp. Gr. 1.10)			
No. 1 Tall	301 x 411	1	1
No. 303	303 x 406	1	1
No. 2	307 x 409	1	5
No. 2½	401 x 411	1	14
No. 10	603 x 700	6	14
Choice (Sp. Gr. 1.07)			
No. 1 Tall	301 x 411	1	.
No. 303	303 x 406	1	.
No. 2	307 x 409	1	4
No. 2½	401 x 411	1	13
No. 10	603 x 700	6	11
Standard (Sp. Gr. 1.05)			
No. 1 Tall	301 x 411	1	.
No. 303	303 x 406	1	.
No. 2	307 x 409	1	4
No. 2½	401 x 411	1	12
No. 10	603 x 700	6	7
Water (Sp. Gr. 1.03)			
No. 1 Tall	301 x 411	1	.
No. 303	303 x 406	1	.
No. 2	307 x 409	1	3
No. 2½	401 x 411	1	12
No. 10	603 x 700	6	7

CRANBERRIES

Cranberries are grown in bogs or swamps in New Jersey, Massachusetts, Oregon, Washington and Wisconsin maturing in the fall. Being a perishable fruit they must be handled as rapidly as possible and if they are to be kept for any period of time this should be done by refrigeration. If the berries are frozen quickly and held at low temperature, then the flavor and quality can be conserved, so that when they are used for canning the resulting product is of high quality. Of course the best flavored sauces and canned cranberries are freshly packed from the fully vine-ripened berries. The sugar content of the berries will increase from 20 to 40% in sugar content during the final 2 to 3 weeks that they are permitted to remain on the vines. They are larger in size, color, flavor and mellowness. Berries stored at ordinary or cool temperatures decrease in sugar, pectin, yield of sauce and flavor.

The berries are usually shipped in 100 pound barrels and upon receipt at the plant are cleaned by passing through a separator thence to a picking table. The cleaning operation removes leaves, sticks, stones, defective berries and any trash after which the berries fall on bounding-boards which causes the good berries to bound over the barriers and the soft-decayed fruit to remain behind.

Cranberries are packed as a strained sauce, wholefruit sauce, and preserves.

Strained Sauce:—In making this product, the cleaned and sorted berries are run into a kettle with an equal amount of water and are cooked or blanched from 2 to 4 minutes in order to break the skins and allow the flesh to soften and liberate the pectin. Insufficient cooking gives low yields because the pectin is not liberated and extracted. Next the cooked berries pass into a pulper or cyclone machine where the skins and seeds are removed. Various mesh screens are used depending upon the consistency desired. Some prefer a smooth, fine texture whereas others prefer a coarse grained sauce with some seeds. The pulp then passes to finishing kettles where sugar is added at the rate of 0.9 to 1.2 parts to 1 part by weight of pulp and cooked until the desired consistency is obtained. This can be determined by several ways. The sheeting or jelly test shows the product to be finished when the jelly "sheets" or "flakes" from the skimmer or cooking spoon. Some determine the finishing point by using the thermometer in conjunction with the "sheeting" test so that when it reaches 216-217° F. it should be finished. Others use a refractometer and when this instrument shows 43%, the product is finished. A yield of between 2 to 3 pounds of finished sauce should result from every pound of berries used.

The sauce is either filled direct from the cooking kettle or run into a reservoir or holding steam jacketed kettle from thence it goes to the fillers. The jelly is kept at a temperature of at least 180° F. and an even higher temperature is better because this product is not sterilized after being sealed. It is quite imperative that the sealed containers can be cooled rapidly by passing them through cold water in order to preserve the high quality of flavor and color. By storing at a cool temperature the sauce retains its original color and flavor and will keep in good condition for approximately a year.

In selecting equipment use only stainless steel, glass enameled, aluminum and nickel alloy metal equipment. Iron

in contact with this fruit will cause a blackness, and tinned kettles will cause the product to assume a purple color, especially if oxygen is present.

Whole Fruit Sauce:—Some people prefer to have the fruit in a semi-whole state. To meet this demand commercially, some manufacture their sauce so as to preserve the berries in as whole a condition as possible. After the berries are carefully washed and sorted, they are cooked with the necessary sugar and water until they form a jelly. In making a finished sauce, practically all of the pectin is liberated whereas in a whole sauce, the berries are not cooked to a pulpy condition and consequently all the pectin is not liberated and a smaller yield therefore results. A yield of about 2.7 pounds of finished sauce results from using 1 pound of berries.

Suggested Label Weights (Net Weight)

Cranberry Sauce (Sp. Gr. 1.17)		Lbs.	Ozs.
No. 300	300 x 407	1	.
No. 2	307 x 409	1	6
No. 10	603 x 700	7	5

CURRANTS (Ribes Rubrum)

Very little of this fruit is packed as there is no special demand for the whole fruit other than for jelly purposes. If canned, the stems must be removed because they will produce an astringent taste. This fruit is often packed in large containers such as 5 gallon cans, for jelly purposes. The fruit is heated to from 180 to 190° F. and filled hot and then sterilized in boiling water for 1 hour. It is more economical to separate the juice from the pulp and pack it for jelly rather than the whole fruit.

Suggested Label Weights (Net Weight)

Currants		Lbs.	Ozs.
Water pack (Sp. Gr. 1.06)			
No. 10	603 x 700	6	10

FIGS

The figs usually canned are the Kadotas, Magnolia, and Calimyrnas but the Kadota predominates. They are packed near the growing centers and in the east are reworked into preserved or glaced figs. The preserved figs are too sweet to be relished but canned ones are packed in a light syrup for dessert.

Kadota figs possess a thick, meaty outer wall with a few small seeds, are firm and hold up well in canning. They have thin skins and are white, requiring no preliminary peeling.

The Calimyrna, a variety of the Smyrna fig, is large and requires artificial pollination. This fig is softer and the seeds more pronounced than in the Kadota.

The Magnolia fig has a thin skin which can easily be removed by dilute hot lye solution.

Figs picked green will not ripen as other fruits but become somewhat mushy with a "chalky" taste.

The figs are gathered when they are firm-ripe and placed in big boxes or grape baskets holding about 25 to 35 pounds each. As a rule they are packed the same day as gathered and handled as quickly as possible to assure a fresh and delicious product. If they are held over night, they should be placed in cold storage until needed. They are graded according to the size and number that will fill No. 10 tins; 17/16 of an inch in diameter are packed 180; 19/16 packed 160; 21/16 packed 140; 23/16 packed 120; 25/16 packed 100; 27/16 packed 80; and 30/16 are packed 60.

Various canning areas pack differently. In Texas the Magnolia figs when ready to be canned are dipped from 10 to 15 seconds in a hot two per cent lye solution held at about 210° F. after which they are sprayed with fresh water and then passed into a bath where they are given a gentle rubbing or agitation to remove the skin. Next they are trimmed and inspected to remove defects. Some grade the figs before giving the lye treatment. The figs are then cooked from two to three hours, depending upon the density of the syrup required. Some have a special basket arrangement that fits inside the cooking kettle so that the cooked figs and syrup can be removed and the figs allowed to cool in the syrup. They are then placed in cans or jars, lids placed, after which they pass through the exhaust box and then are sealed and sterilized at 180° F.

The Calimyrna figs are handled for canning similar to other fruits. They are sorted and graded for size as soon as received and are given a short blanch in hot water and are then packed in cans or glass after which a heavy syrup is added, cans exhausted, sealed and processed in boiling water.

Kadota figs are not lye treated but are blanched or parboiled about three minutes in water ranging from 140 to 180° F. to cleanse them and remove some of the waxy coating and "raw flavor." This preliminary cooking greatly improves the appearance of the finished product. Next they are cooked for about 30 minutes in a light syrup so that the tissues will permit penetration of the syrup used in canning. They are allowed to stand overnight in this syrup and are then canned and covered with a 50° Balling or Brix syrup, exhausted from five to eight minutes, sealed and sterilized in boiling water for one-half hour.

Some factories after blanching, fill them into containers and add a heavy syrup of about 70° Balling, exhaust, seal and sterilize.

Recommended Fill of Container and Drained Weight

The container shall be filled with Kadota figs as full as practicable without impairment of quality. The product and packing medium occupies not less than 90% of volume capacity of the container.

Drained weights of canned Kadota figs are determined by emptying the contents of the container upon a circular sieve of proper diameter, containing 8 meshes to the inch (0.097-inch perforations) and allowing to drain for 2 minutes. A sieve 8 inches in diameter is used for No. 2-½ size containers and smaller, and a sieve 12 inches in diameter is used for containers larger than No. 2-½ size.

The contents of the container should be distributed over the screen so as to form a layer of uniform depth, this being accomplished, so far as possible, by the manner of emptying from the container.

Recommended Minimum Drained Weights—Kadota Figs

Container size or name	Minimum drained weight
8 ounce tall	5¼ ounces
No. 1 tall	10 ounces
No. 303 glass	10¼ ounces
No. 2	13 ounces
No. 2½ glass	17¼ ounces
No. 2½ can	18 ounces
No. 10	66 ounces

SYRUP DENSITY:—"Extra Heavy Syrup" means that the syrup tests 30° or over Brix.

"Heavy Syrup" means that the syrup tests 25° to 30° Brix.

"Medium Syrup" means that the syrup tests 20° to 25° Brix.

"Light Syrup" means that the syrup tests 15° to 20° Brix.

Syrup that tests less than 15° Brix is considered as "Water Pack."

Suggested Label Weights (Net Weight)

Figs		Lbs.	Ozs.
California Fancy (Sp. Gr. 1.14)			
8Z Tall	211 x 304	.	9
No. 1 Tall	301 x 411	1	1
No. 303	303 x 406	1	1

No. 2	307 x 409	1	5
No. 2½	401 x 411	1	14
No. 10	603 x 700	7	.
Choice (Sp. Gr. 1.12)			
8Z Tall	211 x 304	.	9
No. 1 Tall	301 x 411	1	1
No. 2	307 x 409	1	4
No. 2½	401 x 411	1	14
No. 10	603 x 700	7	.
Standard			
No. 2½	401 x 411	1	13
Water (Sp. Gr. 1.05)			
8Z Tall	211 x 304	.	8½
No. 1 Tall	301 x 411	1	.
No. 2	307 x 409	1	4
No. 2½	401 x 411	1	13
No. 10	603 x 700	6	9
Texas (Sp. Gr. 1.16)			
8Z Tall	211 x 304	.	9¼
No. 2	307 x 409	1	6
No. 2½	401 x 411	2	.
No. 10	603 x 700	7	4

FRUITS FOR SALAD OR FRUIT COCKTAIL

This product makes a neat and attractive package when packed properly with the right blend of fruits.

In packing this blend usually peaches, pears, apricots, pineapples and cherries are used. It is optional with the packer as to the kind and amount of each fruit used, but invariably the packer tries to use the same number of pieces of each fruit so they can be uniformly served. Peaches, pears, and apricots that have blemishes can be used, but they are trimmed for specks and bruises and cut to the proper size. The peaches and pears are quartered and also the apricots if large. Pineapple slices are cut into eights or sixteenths.

Maraschino type cherries, when used, are drained of liquor and blanched a short time in water to remove excessive color before being used. Reject the syrup from the cherries. As these cherries are artificially colored and flavored, this should be declared on the label. Uncolored cherries, with the pits in, may be used.

As each fruit used requires a different time for processing instead of packing the fresh fruits when received, the packer usually packs the different fruits separately and during the off season will open the different cans and repack as fruits for salad.

The containers are opened, the drained juice collected and filtered or strained and sugar added to reinforce it to 40° Brix or else concentrated by cooking to 40° Brix. This syrup containing the fruit flavor is then added hot to fruit in cans.

In packing the fruit, several women are used, each one adds the proper number of pieces of fruit that go into each can and the proper weight adjusted by the addition of peaches.

Add the syrup hot, exhaust for about five minutes at 200° F. and process at 212° F. No. 1 can for 10 minutes; No. 2 can 12 minutes; No. 2½ can 12 minutes; No. 3 can 18 minutes; and No. 10 can 30-35 minutes, all in boiling water.

Pack about six pieces of each fruit for a No. 2 can.

Pack about four pieces of each fruit for a No. 1 can.

Soft fruits should not be used as they will disintegrate when sterilized the second time.

Peach halves being separated for size. Fruit passes down vibrating "steps" in which openings are of increasing size.

Fruit Cocktail—Recommended Proportion of Fruits

Fruit	Style Specification	Proportion (Based on weights drained weights) Not less than	Not more than
Peaches	Diced into approximate cubes	30% by weight	50% by weight
Pears	Diced into approximate cubes	25% by weight	45% by weight
Pineapple	Cut into segments not more than ½-inch, but more than 5/16-inch in thickness and not more than 1¼-inches but more than ¾-inch in length, or into approximate ½-inch cubes	6% by weight	16% by weight
Seedless Grapes	Whole	6% by weight	20% by weight
Maraschino Type or Natural Cherries	Halves	2% by weight	6% by weight

SYRUP DENSITY:—Fruit cocktail is usually packed in sugar syrup. Syrup "cut-out" requirements, however, are not incorporated in the grades of the finished product, as syrup as such is not a factor for the purpose of these grades.

"Extra Heavy Syrup" means that the syrup tests 22° or over Brix.

"Heavy Syrup" means that the syrup tests 18° to 22° Brix.

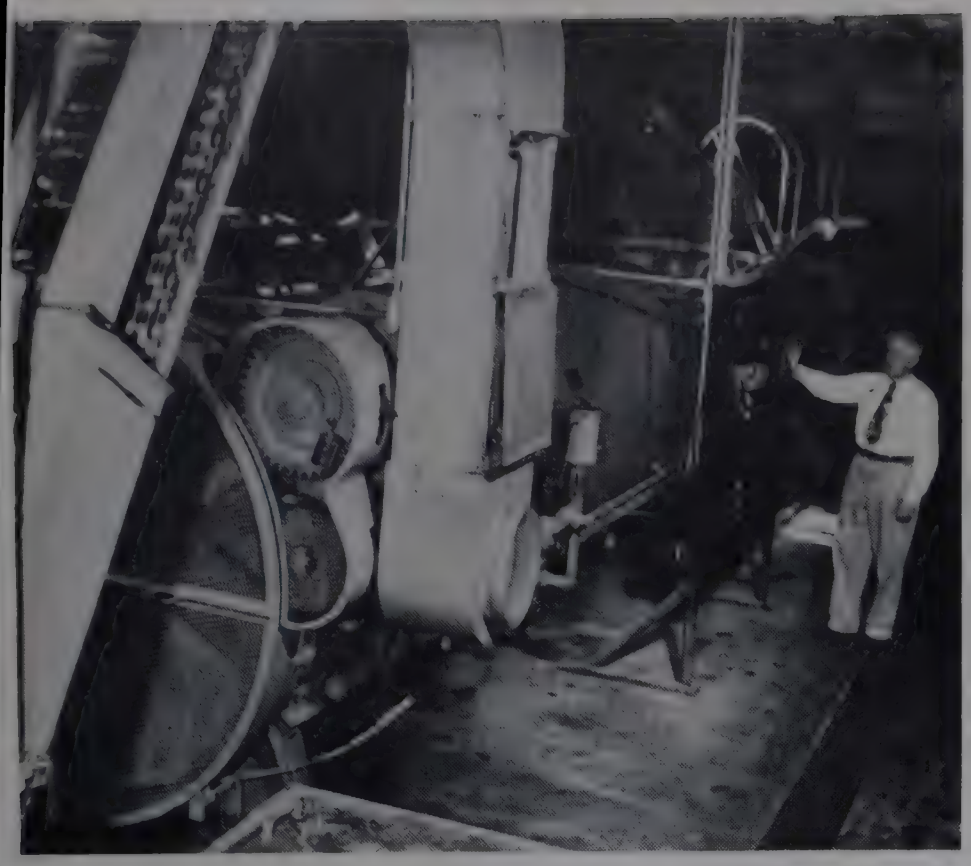
"Medium Syrup" means that the syrup tests 14° to 18° Brix.

"Water pack" means that the packing media tests less than 14° Brix.

Recommended Head Space and Drained Weights

Drained weights of canned fruit cocktail are determined by emptying the container contents upon a circular sieve of proper diameter containing 8 meshes to the inch (0.097-inch perforations) and allowing to drain for 2 minutes. The sieve diameters used are: 8 inches for No. 2½ size containers or smaller, and 12 inches for No. 10 size cans.

The maximum head space and the minimum drained weight allowable in the containers commonly used in packing fruit



Continuous pressure cooker and cooler in fruit canning plant. A can of peaches passes through machine in 16 minutes.

cocktail are shown in the following table. For can sizes not mentioned herein the minimum drained weight is calculated as 65% of the capacity of the can in water at 68° F.

Container Size	Maximum head space allowable (measured from top of double seam in 16ths of an inch)	Minimum drained weight (in ounces)
8 ounce	7.6	5½
No. 1 tall	9.9	11
No. 2	9.7	13¼
No. 2½	9.9	19¼
No. 10	13.6	71

Suggested Label Weights (Net Weight)

Fruit Cocktail		Lbs.	Ozs.
Fancy (Sp. Gr. 1.10)			
8Z Tall	211 x 304	.	8¾
No. 1 Tall	301 x 411	1	1
No. 2	307 x 409	1	5
No. 2½	401 x 411	1	14
No. 10	603 x 700	6	14
Choice (Sp. Gr. 1.08)			
8Z Tall	211 x 304	.	8¾
No. 1 Tall	301 x 411	1	.
No. 2	307 x 409	1	4
No. 2½	401 x 411	1	14
No. 10	603 x 700	6	12

Fruits for Salad—Recommended Proportion of Fruits

Fruit	Style	Proportion (Based on Drained Weight) Not less than	Not more than
Yellow Cling Peaches	Peeled (halves, quartered, or sliced)	24%	40%
Apricots	Peeled or unpeeled (halves)	18%	30%
Pears	Peeled and cored (halved, quartered, or sliced)	21%	35%
Pineapple	Wedge shaped segments.	8%	16%
Cherries or	Maraschino type or natural whole, pitted cherries	3%	8%
Grapes	Whole natural or artificially colored grapes	3%	8%

SYRUP DENSITY:—Canned fruits for salad are usually packed in syrup. Syrup "cut-out" requirements, however, are not incorporated in the grades of the finished product, as syrup, as such, is not a factor of quality for the purpose of these grades.

"Extra Heavy Syrup" means that the syrup tests 22° Brix or over.

"Heavy Syrup" means that the syrup tests 18° to 22° Brix.

"Light Syrup" means that the syrup tests 14° to 18° Brix.

"Water, Slightly Sweetened" means that the syrup tests less than 14° Brix.

"Water Pack" means that the product is packed in water.

Fill of Container and Recommended Drained Weight

The container shall be filled with fruits for salad as full as practicable without impairment of quality. The product and packing medium shall occupy not less than 90% of the total volume capacity of the container.

Drained weights of canned fruits for salad are determined by emptying the container contents upon a circular sieve of proper diameter containing 8 meshes to the inch (0.097-inch perforations) and allowing to drain for 2 minutes. A sieve 8 inches in diameter is used for No. 2½ containers and smaller, and a sieve 12 inches in diameter is used for No. 10 cans.

Recommended Minimum Drained Weights——Fruits for Salad

Container Size	Recommended minimum drained weights
8 oz.	5¼ ounces
No. 1 Tall	10 ounces
No. 2	12½ ounces
No. 2½	18 ounces
No. 10	64½ ounces

Suggested Label Weights (Net Weight)

Fruits for Salad		Lbs.	Ozs.
Fancy (Sp. Gr. 1.10)			
8Z Tall	211 x 304	.	8¾
No. 1 Tall	301 x 411	1	1
No. 2	307 x 409	1	5
No. 2½	401 x 411	1	14
No. 10	603 x 700	6	14
Choice (Sp. Gr. 1.08)			
8Z Tall	211 x 304	.	8¾
No. 1 Tall	301 x 411	1	.
No. 2	307 x 409	1	4
No. 2½	401 x 411	1	14
No. 10	603 x 700	6	12

GOOSEBERRIES (Ribes Grossularia)

Very few gooseberries are packed in this country as there is little demand for them. The fruit is picked as it begins to ripen. The leaves are removed by passing through a fanning mill and then the fruit passes through hulling machines to remove stems and bloom after a thorough wash. Fill into plain cans or glass containers and cover with water but preferably with a 10° syrup. Exhaust until the center reaches 150° F. Process 12 minutes for No. 2 cans and 15 minutes if heavy syrup is used and 15 to 20 minutes for No. 10's at 212° F.

Fancy grade is packed in 60° Brix syrup. Choice grade is packed in 40° Brix syrup. Standard grade is packed in 20° Brix syrup. Second grade is packed in 10° Brix syrup.

This fruit like currants and grapes is used more for jelly and jam making, very little being packed for retail sale.

Suggested Label Weights (Net Weight)

Gooseberries		Lbs.	Ozs.
Fancy (Sp. Gr. 1.10)			
8Z Tall	211 x 304	.	8¾
No. 1 Tall	301 x 411	1	1
No. 303	303 x 406	1	1

No. 2	307 x 409	1	5
No. 2½	401 x 411	1	14
No. 10	603 x 700	6	14
Choice (Sp. Gr. 1.05)			
8Z Tall	211 x 304	.	8½
No. 1 Tall	301 x 411	1	.
No. 303	303 x 406	1	.
No. 2	307 x 409	1	4
No. 2½	401 x 411	1	13
No. 10	603 x 700	6	9
Water (Sp. Gr. 1.01)			
No. 1 Tall	301 x 411	.	15½
No. 303	303 x 406	.	15½
No. 2	307 x 409	1	3
No. 2½	401 x 411	1	12
No. 10	603 x 700	6	5

GRAPEFRUIT (Citrus Grandis)

The fruit used for canning purposes is known as "culls," i.e., the fruit that is too large to ship, is blemished, due to scab spots or of an odd shape often called "grove run." Fruit that is not up to the standard for eating purposes should not be used. It should be tree ripened and well matured in order to obtain maximum flavor and minimum astringency and bitterness.

In packing this product, the idea is to use up fruit that cannot be sold on account of blemishes and yet it may have a better flavor than some of the perfect fruit that is shipped. Usually for shipping purposes, especially the California fruit (when shipped east) is picked green and ripened en route, consequently the fruit does not have the same flavor as though properly matured.

There are several successful methods of preparing grapefruit for canning.

FIRST METHOD:—Place fruit in tanks of boiling water for 3½ minutes in order to loosen the skin so that it can be easily removed. This does not eliminate the white membrane covering the fruit which must also be removed because of its bitterness and in order to separate the segments. This may be done by passing the fruit under a spray of boiling 2 to 2½% caustic soda for 30 seconds. Some use from 1.5 to 2% lye solution to from 10 to 15 seconds with very good results. Lye treatment partly neutralizes excessive acidity, producing a sweeter product but the delicate flavor is affected. Prolonging this treatment is apt to disintegrate the membrane causing the juice sacks to "bleed" as the lye is heated to boiling when used. They are then passed through fresh cold water to remove any of the free alkali present as well as any membrane clinging to the fruit. The next procedure is to use a knife to separate the segments or "meats" from the tissue before packing. A bamboo knife or special blunt knife is preferred.

The peel and white membrane are removed by peeling with knives after which the fruit segments are separated from the membrane and packed in plain cans.

SECOND METHOD:—Hand peel fruit by removing the outside skin with a knife without first treating with hot water. There are certain times when the lye peeling method works to better advantage than the knife peeling method and again just the reverse. When peeled with a knife, some of the adjacent fruit may also be removed and the yield therefore lower, whereas with over ripe fruit a lower yield results when the fruit is lye peeled.

A solid pack is desired so that when the consumer opens the container, it will not have small pieces and excess juice, but will be filled with fruit and a minimum amount of juice. Formerly fruit was filled into containers with no thought as to the arrangement, but now the packer is endeavoring to place the segments either as it occurs in the fruit or by

Grapefruit segments being separated and packed in cans. Bamboo knife or special blunt knife is preferred for separating

the "so-called" pineapple pack, placing the segments with convex side out. No. 1, 2, and 5 are the sizes mostly packed. There should be about 17 ounces of fruit and 4 ounces of syrup for a No. 2 container.

Some add dry sugar to each can of fruit and then hot water. Use 1.6 to 2 ounces per No. 2 can. As the sugar is rather slow in dissolving and penetrating the mass, it is not so readily pasteurized as with syrup, and a longer process will be required.

PLAIN CANS are more satisfactory than enameled ones because fewer hydrogen springers develop, and therefore smaller losses occur. Fruit packed in enameled cans become yellower than when packed in plain cans. Also, the reducing action of the tin has a bleaching effect upon the color. The flavor is superior when grapefruit is packed in plain tin.

SYRUPING:—The juice from the fruit is never used, as it is often too sour and has a slight bitterness. Sugar syrup varying in strength from 35 to 50° Brix is used, but a 40° syrup is preferred as a stronger one produces a finished product which is too sweet. The syrup is added by hand fillers on account of the solid pack and slow penetration. Many cover with about a 15% sugar syrup instead of the heavy one. The packer should be guided by the ripeness of the fruit as well as the quality desired.

As grapefruit has a delicate flavor greatly affected by high temperatures, the heated syrup used should not exceed 180° F.

EXHAUST:—Filled and syruped (or sugared) cans are lightly crimped to hold the lids in place before going through an exhaust box, so as to prevent the fruit from rising over the top and spilling.

Exhausting may be done with live steam or hot water, the latter being preferable. While steam is quicker, it is too intense on the sides, top and bottom, and may break the small juice cells. The hot water exhaust is less violent and if prolonged for 10 to 15 minutes in water having a temperature of 180° F. will be satisfactory for No. 1's. The hot water causes heat waves (convectional currents) of the syrup to rise and circulate, thereby producing a more uniform result. Exhaust No. 2's 15 to 20 minutes and 5's 25 minutes at 180° F. Hot water exhaust may be any temperature desired, but usually 180° F. is preferred. A higher temperature will affect the delicate flavor by giving it a cooked taste.

The cans may then be tightly sealed and processed.

Another method closes unheated cans or glass containers

with a vacuum machine, using from 22 to 25 inches, after which the containers are sterilized.

PROCESSING:—No. 1 cans are retorted 25 min. at 180° F.; No. 2's 30 minutes at 180° F.; and No. 5's after a 20 minute exhaust, 40 minutes at 180° F. There is very little danger of spoilage in grapefruit due to its high acidity, which is an aid in pasteurizing at low temperatures. Grapefruit used to be cooked at 212° F., for from 6 to 8 minutes, but the high temperature affects the flavor, color, and quality. Overfilling must be avoided and prompt handling is necessary to prevent swells. In the non-agitation continuous cooker 30 minutes at 160° F. is sufficient for 2's.

After processing, containers are cooled as rapidly as possible, allowing just enough heat to remain to dry them and prevent rusting of the cans.

The cans are then packed in cases and permitted to stand undisturbed for several weeks to allow the gelatinous membrane surrounding the juice sack to set or become firm.

SYRUP DENSITY:—Canned grapefruit is usually packed in syrup. Syrup "cut-out" requirements, however, are not incorporated in the grades of the finished product.

"Heavy Syrup" or "Heavy Grapefruit Juice Syrup" means that the syrup tests 18°, or over, Brix.

"Light Syrup" or "Light Grapefruit Juice Syrup" means that the syrup tests 16° to 18° Brix.

"Water, Slightly Sweetened" or "Grapefruit Juice Slightly Sweetened" means that the syrup tests less than 16° Brix.

"Water Pack" means that the product is packed in water.

"Juice Pack" means that the product is packed in natural grapefruit juice.

Fill of Container

The container shall be filled with grapefruit as full as practicable without impairment of quality. The product and packing medium shall occupy not less than 90% of the total volume capacity of the container.

In canned grapefruit, the drained weight is a factor in establishing the grade of the commodity. Drained weights of canned grapefruit are determined by emptying the contents upon a circular sieve of proper diameter containing 8 meshes to the inch (0.097-inch perforations) and allowing to drain off for 2 minutes. A sieve 8 inches in diameter used for No. 2½ size containers and smaller, and a sieve 12 inches in diameter is used for containers larger than No. 2½ size.

"Capacity of the container" means the weight of distilled water at 68° F. which the sealed container will hold.

(A) If the drained weight is 60% or more of the capacity of the container, a score of 18 to 20 points may be given.

(B) If the drained weight is 55% to 60% of the capacity of the container, a score of 15 to 17 points may be given. Grapefruit that falls into this classification shall not be graded above U. S. Grade B or U. S. Choice, regardless of the total score for the product.

Container Size		No. 2	No. 3 Cyl.	No. 5
Score Points	Drained Grapefruit (percent of capacity of container)	Drained Weights (Ounces)	(Ounces)	(Ounces)
20	65 or more	13¼	32¼	38½
19	62½ to 65	12¾	31	37
18	60 to 62½	12¼	29¾	35½
17	58 to 60	12	28¾	34½
16	56½ to 58	11½	28	33½
15	55 to 56½	11¼	27¼	32½

Suggested Label Weights (Net Weight)

Grapefruit (Sp. Gr. 105)		Lbs.	Ozs.
8Z Tall	211 x 304	.	8
No. 300	300 x 407	.	14½
No. 2	307 x 409	1	4
No. 3 Cylinder	404 x 700	3	2

GRAPES (Vitis Vinifera)

There is also little demand for this product, consequently small quantities are packed. The fruit is stemmed, washed, filled (to top) into containers and covered with warm 30° Brix syrup, exhausted 8 minutes at 180° F. or 4 minutes at 212° F. and then processed 14 minutes at 212° for No. 2½ or 3 containers. Only choice fruit should be used, the same quality that is used for grape juice. Unless stems are removed, an unsightly as well as astringent taste will result.

Handling by this method produces a fine grape juice as all of the natural aroma and bouquet is retained. The canned fruit can be strained or pressed to obtain the greatest amount of juice. This juice cannot be sold as grape juice unless labeled containing added syrup.

Suggested Label Weights (Net Weight)

Grapes		Lbs.	Ozs.
Fancy (Sp. Gr. 1.10)			
8Z Tall	211 x 304	.	8¾
No. 1 Tall	301 x 411	1	1
No. 2	307 x 409	1	5
No. 2½	401 x 411	1	14
No. 10	603 x 700	6	14
Choice (Sp. Gr. 1.08)			
8Z Tall	211 x 304	.	8¾
No. 1 Tall	301 x 411	1	.
No. 2	307 x 409	1	4
No. 2½	401 x 411	1	14
No. 10	603 x 700	6	12
Standard (Sp. Gr. 1.06)			
8Z Tall	211 x 304	.	8½
No. 1 Tall	301 x 411	1	.
No. 2	307 x 409	1	4
No. 2½	401 x 411	1	13
No. 10	603 x 700	6	10
Seconds			
No. 2½	401 x 411	1	12
Water			
No. 2½	401 x 411	1	12
No. 10	603 x 700	6	8
Pie			
No. 10	603 x 700	6	10

LOGANBERRY

This berry is a cross between a wild blackberry and raspberry, but has characteristics distinctly its own. It is about the same size and shape as a blackberry with the red color of the Cuthbert raspberry, but with more acidity than either. As this berry is soft and disintegrates easily, it must be handled with care. It is used extensively for jellies, jams, and syrups.

Process No. 1 can—13 minutes at 212° F. Process No. 2½ can—12 to 15 minutes at 212° F. Process No. 10 can—40 minutes at 212° F.

On account of the high acidity and anthocyan pigments present in the loganberry, cans pinhole readily. They should be packed in lacquered cans or glass containers with a heavy syrup to improve and retain the color and flavor. For baker's trade, the berries are packed in No. 10 tins either in water or light syrup. Exhaust and process the same as blackberries. The syrups used are 70° for Fancy, 50° for Choice.

Suggested Label Weights (Net Weight)

Loganberries		Lbs.	Ozs.
Fancy (Sp. Gr. 1.13)			
8Z Tall	211 x 304	.	9
No. 1 Tall	301 x 411	1	1
No. 303	303 x 406	1	1
No. 2	307 x 409	1	5
No. 2½	401 x 411	1	15
No. 10	603 x 700	7	1

Choice (Sp. Gr. 1.10)			
8Z Tall	211 x 304	.	8¾
No. 1 Tall	301 x 411	1	1
No. 303	303 x 406	1	1
No. 2	307 x 409	1	5
No. 2½	401 x 411	1	14
No. 10	603 x 700	6	14
Standard (Sp. Gr. 1.06)			
No. 10	603 x 700	6	10
Water (Sp. Gr. 1.03)			
No. 10	603 x 700	6	7

PEACHES (Prunus Persica)

The peaches used should be hand picked from the trees, ripe but not soft with flavor developed, and be as free as possible from blemishes and soft spots. In the East the peaches are shipped in so-called "peach" or ⅝-bushel baskets, whereas in the West they are handled in boxes or lugs.

Upon arrival at the factory, they may be prepared for canning by several methods: (1) hand peeled, (2) steaming, and (3) lye peeled.

HAND PEELING AND STEAMING:—Labor cost in hand peeling is greater than the lye process. The skin of certain varieties of peaches may be removed by subjecting the halved peaches to live steam for about 3 minutes. The peaches are arranged on slated trays with skin side up. The fruit needs no blanching under this method of handling.

LYE PEELING:—Peaches are delivered to the workers who cut or split one side of the peach, and with a pitting spoon remove the seed. Once all peaches were pitted by hand, but there is a mechanical pitter that will pit all sizes of peaches effectively.

The halves are then conveyed to lye peeling machines where they are automatically subjected to a 1 to 3% caustic soda solution requiring from 45 to 60 seconds as they pass through so as to cauterize or dissolve the skin.

In peeling peaches, "lye" (sodium hydroxide) is used more than any other cauterizing substance. It is reasonably cheap, pure, and very effective. "Soda ash," "sal soda" or "washing soda" is also used, but is not so effective although reasonable in price. Potash lye or potassium hydroxide can be used just as effectively as the soda lye, but costs more and consequently is not used so extensively. It requires about 6 to 9 pounds of lye to peel one ton of fruit, depending upon the ripeness.

No stronger solution should be used than is necessary to effectively perform the task. The solution should be tested at least four times a day and even oftener when the canning is at its maximum. The solution should be tested in the morning before starting to peel; then about the middle of the forenoon and again when starting after lunch; also about the middle of the afternoon. Do not use hydrometers in making this test as they are not accurate. The lye solution contains neutralized acid salts, pectin, and sugars extracted from the peach, thus changing the actual percentage of "lye" but according to the hydrometer the solution may show a solution of the proper strength or even higher when in reality it is far below the standard adopted. The only accurate method is to calculate the actual percentage by careful titration with a standard acid solution preferably a tenth normal one (N/10). This method of testing for percentage of alkali is just the opposite of the one used in testing vinegar for acidity. Use the tenth normal acid solution that was used in making tenth normal alkali (so-called soda solution). Fill the burette with the acid, then measure accurately 10 c.c. of the cooled solution to be tested into a glass bottle or flask and add about 2 ounces distilled water and a few drops of phenolphthalein indicator and then slowly add the acid until the pink color has disappeared. Then read the number of c.c. of the acid solution required to exactly neutralize the alkali (turn it

One man operates this pallet unloader and lug box dumper which can dump tiers of lug boxes onto conveyor at 58 tons per hour.

colorless). For example: If 10 c.c. required 40.0 c.c. of tenth normal acid, then 40 x .004=0.16% in 10 c.c. or 0.16 x 10= 1.60% of alkali in the solution tested. 1 c.c. tenth normal acid will neutralize .004 grams of sodium hydroxide.

There are several types of peeling machines. One machine gives the halved peaches a hot water bath or spray first to heat the fruit and permit more rapid action of the alkali. The fruit then passes through a long box on a woven wire belt where sprays of hot lye hit the fruit from above and below so that all portions receive the same treatment. Then the fruit is well sprayed with water as it passes along so as to remove the skin and lye.

Other methods use revolving cylinders and pass the fruit through a tank of boiling lye, then through hot water, and finally through two rotary drum washers containing fresh running water where the loose skin and lye is removed. It is well to have a continuous process and blanch immediately to prevent oxidation or browning, then cool and pack.

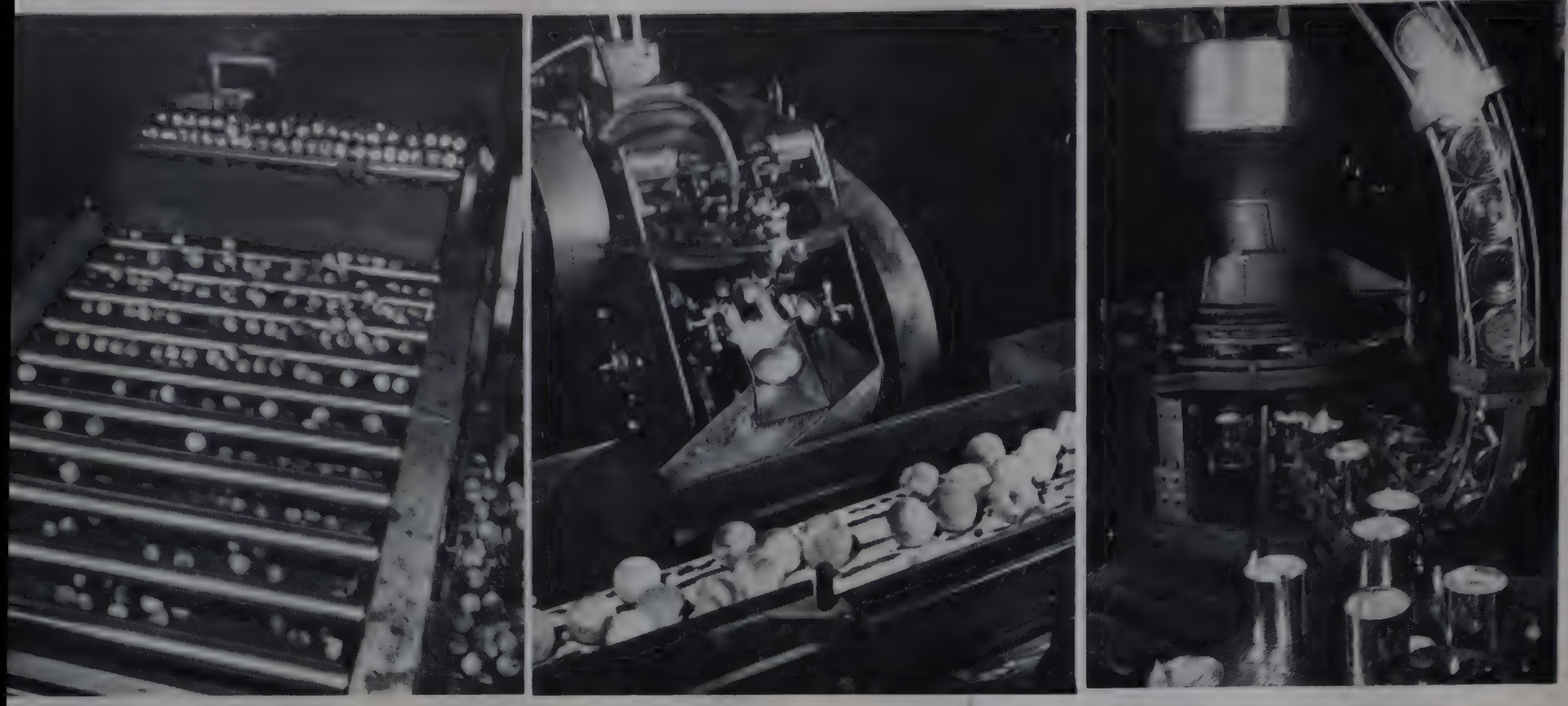
The next step is to convey the clean fruit along sorting belts where the defective, soft, and blemished fruit is removed, after which they are automatically graded by sorting machines into as many grades as are packed. The peaches are then blanched for two minutes at from 185 to 212° F. (depending upon the ripeness of the fruit) by passing them automatically through hot water or steam. They are then filled and hot syrup at 212° F. added after which they are exhausted, sealed and pasteurized.

The syrup used depends upon the quality packed. The highest grade requiring 55% and the lowest being packed in water. Usually only a 55% syrup is made and then diluted to the strength desired which may be 40, 25, and 10%.

Filled and syruped containers are then passed through an exhaust box where they are heated for different periods, again depending upon the character of the fruit, but the center of the containers should be at least 160° F. They should be heated sufficiently to make the fruit tender but not soft.

Some prefer to give a long exhaust of 12 to 20 minutes at boiling temperature while others give only 5 to 6 minutes at about 200 -205° F.

No. 2 cans, if water pack, 15 minutes; if syrup, 20 minutes at 212° F. The cans (No. 2½) are processed at 212° F. from 12 for ripe to 22 minutes for medium ripe and 30 to 35



Left: Four-grade peach sizer sorts fruit for pre-set pitters and slicers. Center: Graded fruit passes to pitter which cuts through peach and pit, then removes pit portions. Right: Filler vibrates to settle fruit in containers, 250 cans per minute.

minutes for green peaches, while No. 10 is given 45 minutes and then well cooled before storing.

Types of Canned Peaches

Clingstone peaches are peaches having stones or pits which adhere to the flesh.

Freestone peaches are peaches, the flesh of which separates readily from the stones or pits.

Styles of Canned Yellow Clingstone Peaches

Halved canned peaches are peeled and pitted peaches, cut approximately in half along the suture from stem to apex.

Quartered canned peaches are halved peaches cut into two approximately equal parts.

Diced canned peaches are peeled and pitted peaches cut into cubes.

Sliced canned peaches are peeled and pitted peaches prepared by slicing the halved peaches longitudinally.

Whole canned peaches are whole peeled peaches and are unpitted.

SYRUP DENSITY:—U. S. Grades A, B, and C clingstone peaches are usually packed in syrup. Syrup "cut-out" requirements, however, are not incorporated in the grades of the finished product since syrup, as such, is not a factor of grade for the purpose of these grades.

"Extra heavy syrup" means that the syrup tests 24° or more, but not more than 35° Brix.

"Heavy syrup" means that the syrup tests 19° to 24° Brix.

"Light syrup" means that the syrup tests 14° to 19° Brix.

"Water, slightly sweetened" means that the syrup tests less than 14° Brix.

"Water pack" means that the product is packed in water.

Fill of Container and Recommended Drained Weight

The container shall be filled with clingstone peaches as full as practicable without impairment of quality. The product and packing medium shall occupy not less than 90% of the total volume capacity of the container.

Drained weights of clingstone peaches are determined by emptying contents of can or glass container upon a circular sieve of proper diameter containing 8 meshes to the inch (0.097-inch perforations) and allowing to drain for 2 minutes. A sieve 8 inches in diameter is used for No. 2½ containers and smaller, and a sieve 12 inches in diameter is used for No. 10 cans.

Recommended Minimum Drained Weights—Clingstone Peaches

Halved or Quartered

Container size	Recommended minimum drained weights (in ounces)					
	Extra heavy syrup	Heavy syrup	Light syrup and water slightly sweetened	Water pack	U. S. Grade D (Seconds or Water Grade)	U. S. Grade C or D (Solid Pack)
8 oz.	5	5¼	5½	5½		
No. 1 Tall	10¼	10½	10¾	10¾		
No. 2	12½	12¾	13¼	13¼		
No. 2½	17¾	18½	19	19	20	25½
No. 10	66	68	70	70	76	92

Sliced

Can size	Recommended minimum drained weights (in ounces)					
	Extra heavy syrup	Heavy syrup	Light syrup and water slightly sweetened	Water pack	U. S. Grade D (Seconds or Water Grade)	U. S. Grade C or D (Solid Pack)
8 oz.	5	5¼	5½	5½		
No 1 Tall	10	10¼	10½	10½		
No. 2	12¼	12½	13	13		
No. 2½	17½	18	18½	18½	20	25½
No. 10	64	66	68	68	76	92

Styles of Canned Freestone Peaches

Halved canned peaches are peeled and pitted peaches, cut approximately in half along the suture from stem to apex.

Quartered canned peaches are halved peaches cut into two approximately equal parts.

Sliced canned peaches are peeled and pitted peaches prepared by slicing the halved peaches longitudinally.

Diced canned peaches are peeled and pitted peaches cut into cubes.

Whole canned peaches are whole peeled peaches and are unpitted.

SYRUP DENSITY:—U. S. Grades A, B, and C freestone peaches are usually packed in syrup. Syrup "cut-out" requirements, however, are not incorporated in the grades of the finished product since syrup, as such, is not a factor for the purpose of these grades.

"Extra heavy syrup" means that the syrup tests 24° or more, but not more than 35° Brix.

"Heavy syrup" means that the syrup tests 19° to 24° Brix.

"Light syrup" means that the syrup tests 14° to 19° Brix.

"Water, slightly sweetened" means that the syrup tests less than 14° Brix.

"Water pack" means that the product is packed in water.

Fill of Container

The container shall be filled with freestone peaches as full as practicable without impairment of quality. The product and packing medium shall occupy not less than 90% of the total volume capacity of the container. Freestone peaches that have not been packed as full as possible without impairment of quality will be certified as "Below Standard in Fill".

Suggested Label Weights (Net Weight)

Peaches		Lbs.	Ozs.
Fancy (Sp. Gr. 1.10)			
8Z Tall	211 x 304	.	8¾
No. 1 Tall	301 x 411	1	1
No. 303	303 x 406	1	1
No. 2	307 x 409	1	5
No. 2½	401 x 411	1	14
No. 10	603 x 700	6	14
Choice (Sp. Gr. 1.08)			
8Z Tall	211 x 304	.	8¾
No. 1 Tall	301 x 411	1	.
No. 303	303 x 406	1	.
No. 2	307 x 409	1	4
No. 2½	401 x 411	1	13
No. 10	603 x 700	6	12
Standard (Sp. Gr. 1.06)			
8Z Tall	211 x 304	.	8½
No. 1 Tall	301 x 411	1	.
No. 303	303 x 406	1	.
No. 2	307 x 409	1	4
No. 2½	401 x 411	1	13
No. 10	603 x 700	6	10
Seconds			
No. 2½	401 x 411	1	12
Water (Sp. Gr. 1.03)			
No. 1 Tall	301 x 411	1	.
No. 303	303 x 406	1	.
No. 2	307 x 409	1	3
No. 2½	401 x 411	1	12
No. 10	603 x 700	6	7
Pie			
No. 10	603 x 700	6	8
No. 10 solid pack	603 x 700	6	8

PEARS (Pyrup Communis)

The fruit when picked should be firm, but not soft, fully flavored, and good texture. Pears must be ripe, as otherwise they lack sweetness and flavor and are flat and insipid. If they are not ripe when picked, they will wilt and shrink during storage before they can be used, and if too ripe will become soft, gritty in texture, and will lack juice.

During the ripening period on the trees, the fruit is tested frequently as to texture by a portable instrument known as a pressure tester, or "iron thumb." The idea of using a tester is that the structure of the pear breaks down as it ripens and the resistance to pressure on the surface is lessened.

For Bartlett pears a pressure of from 26 to 32 pounds with a 7/16 inch plunger is used on the unpeeled fruit, but when the Federal or Balluf tester is used, the standard ranges from 16 to 20 pounds with a 5/16 inch plunger.

In order to avoid grits in the canned product it is necessary to pick the pears while still firm and green in appearance. Using the Oregon tester, the Bartlett pear when harvested should show pressure from between 32 and 26 pounds. Cold storage of some kind is indispensable for the disposal of the pear crop for canning if grits are to be avoided. Cold storage

Filled jars of peaches are shown being transferred from syru er at right to exhaust chamber. Exhaust time depends on frui

temperature of from 30 to 32° is maintained, but before can ning the pears are removed from storage and allowed t ripen at temperatures of 60 to 70° F., for 7 days, if the bes quality is desired.

Pears are then scalded for a fraction of a minute in steam and then passed through a squirrel cage washer where the are subjected to a spray of cold water. From the washer the are collected in pans and are placed on the trimming tabl where the skins are slipped off, the pears halved and cored

The fruit delivered to the factory is graded for size and quality and the substandard fruit is either returned to the grower or he is paid a lower price. The regular stock i worked up first and then the low-grade is handled later when time permits and the rush is over.

On account of the irregular shape and the stone cells pres-

Freestone peach pitting table. Pit is removed by inserting into a double-bladed knife. Caustic soda bath then removes skin.

ent, until recently it has been impossible to peel the fruit mechanically or by the lye process. The lye softens the tissue between the stone cells, which is removed by spraying, and leaves a rough surface due to the exposed stone cells.

Because of rapid discoloration, pears must be peeled and submerged either in plain water or dilute salt solution (1%) as soon as possible. Hand peeling is done with a special curved knife having a guard which limits the thickness of the peeling.

The fruit is then halved, cored, trimmed, stemmed, and blossoms removed.

Pears may be peeled mechanically in a peeler which resembles a vegetable peeler, but instead of using a carborundum abrasive lining, a specially prepared rubber cylinder and disc that agitates the fruit and leaves the pears with a smooth surface is used. The machine runs at approximately 300 R.P.M. and handles a charge of 40 pounds and requires 10 to 15 seconds for peeling. This saves considerable labor cost and is worthy of consideration.

Another machine will peel, split, stem and core the pear. A single operator at this machine may turn out about twelve times as many pears as were formerly produced, at a greatly reduced cost of production. In addition, the canned pears do not show the knife marks.

Another machine has been invented for halving the pears after they have been peeled. When the pears are discharged from the peeler they pass to a machine which centers them before they are halved by a revolving knife. This machine will cut about a hundred pears per minute more accurately than hand halving.

There is another automatic system for peeling pears. When it is used the pears must have the right degree of ripeness. If too ripe there is too great a waste and if not ripe enough they are improperly peeled which necessitates rehandling. The pears are fed automatically to a tank where they are given a hot water treatment, under proper temperature control, depending upon the ripeness of the fruit. They are next plunged into cold water and then conveyed to the peeler. This consists of a rapidly revolving cone made of sponge rubber, which revolves within a cylinder lined with the same material so that the pears must pass through the two rubber surfaces which removes the skin by friction. The pears fall to a sorting belt and the skins to a refuse pit. Any skins clinging to the pears can usually be removed by slipping them through the operator's hand. Some pears may require a second water treatment to soften the skin.

Just before the pears go to the fillers, they are often sprayed with cold water to clean and aid in checking oxidation or discoloration.

The grading for quality and size may be done partially by the peelers but the final grading is made by those who fill the cans or glass containers. Because of shape, it requires care and skill to properly pack and obtain the weights, without breaking the fruit.

Either sugar or syrup is added before exhausting. Use about 2½ ounces of sugar for a No. 3 container and fill with hot water. As pears contain less acid than other fruits, in order to obtain the proper flavor, it is not necessary to use a syrup of high sugar content.

The cans of pears are exhausted from 6 to 8 minutes at 180 to 190° F. before sealing, and then processed from 10 to 20 minutes depending upon the ripeness of the fruit. The following are the processes used in a rotary cooker.

Process

No. 1 tall 10 to 15 minutes at 212° F.
No. 2 tall 25 minutes at 212° F.
No. 2 can 25 minutes at 212° F.
No. 2½ can 25 minutes at 212° F.
No. 10 can 25 to 35 minutes at 212° F.
Cool after processing to prevent pink discoloration.

Styles of Canned Pears

Halved canned pears are peeled pears cut approximately in half longitudinally from stem to calyx, with cores and stems removed.

Quartered canned pears are peeled pears cut approximately in quarters longitudinally from stem to calyx, with cores and stems removed.

Sliced canned pears are halved pears sliced longitudinally.

Diced canned pears are peeled pears, with cores and stems removed, cut into cubes.

Whole canned pears are whole peeled or unpeeled pears, with or without stems.

SYRUP DENSITY:—U. S. Grades A, B, C, and D of pears are usually packed in syrup. Syrup "cut-out" requirements, however, are not incorporated in the grades of the finished product since syrup, as such, is not a factor for the purpose of these grades.

"Extra heavy syrup" means that the syrup tests 22° or more, but not more than 35°, Brix.

"Heavy syrup" means that the syrup tests 18° to 22° Brix.

"Light syrup" means that the syrup tests 14° to 18° Brix.

"Water, slightly sweetened" means that the syrup tests less than 14° Brix.

"Water pack" means that the product is packed in water.

Fill of Container and Recommended Drained Weight

The container shall be filled with pears as full as practicable without impairment of quality. The product and packing medium shall occupy not less than 90% of the total volume capacity of the container.

Drained weights of canned pears are determined by emptying contents of the can or glass container, with pit cavities down, upon a circular sieve containing 8 meshes to the inch (0.097-inch perforations) and allowing to drain for 2 min. A sieve 8 in. in diameter is used for No. 2½ containers and smaller, and a sieve 12 inches in diameter is used for No. 10 cans.

Recommended Minimum Drained Weights—Pears

Count Range	Recommended Minimum Drained Weights (in ounces) Can Size				
	8 oz.	No. 1 Tall	No. 2	No. 2½	No. 10
3— 6 Halves	4½	9¼	11½	16½	
7— 9 "	4¾	9½	12	17	
10—12 "		10	12¼	17½	
13—15 "				18	
16—22 "				18½	63
23—30 "					63½
31—40 "					64
41 Halves and over					65
U. S. Grade E (Water Grade)				20	76
U. S. Grade F (Solid-Pack Pie)				25½	92

Suggested Label Weights (Net Weight)

Pears		Lbs.	Ozs.
Fancy (Sp. Gr. 1.03)			
8Z Tall	211 x 304	.	8¾
No. 1 Tall	301 x 411	1	.
No. 303	303 x 406	1	.
No. 2	307 x 409	1	4
No. 2½	401 x 411	1	14
No. 10	603 x 700	6	12
Choice (Sp. Gr. 1.06)			
8Z Tall	211 x 304	.	8½
No. 1 Tall	301 x 411	1	.
No. 303	303 x 406	1	.
No. 2	307 x 409	1	4
No. 2½	401 x 411	1	13
No. 10	603 x 700	6	10
Standard (Sp. Gr. 1.05)			
8Z Tall	211 x 304	.	8½

No. 1 Tall	301 x 411	1	.
No. 303	303 x 406	1	.
No. 2	307 x 409	1	4
No. 2½	401 x 411	1	13
No. 10	603 x 700	6	9
Seconds			
No. 2½	401 x 411	1	12
Water (Sp. Gr. 1.02)			
No. 2½	401 x 411	1	12
No. 10	603 x 700	6	6

PINEAPPLE (Ananas Sativa)

This fruit while a native of America is now growing in all tropical countries. It was first packed in Maryland, and the demand has been so great that it is now packed nearer the source of supply where the soil and climate are well adapted to produce finely flavored fruit. To obtain the best results, the fruit must be picked when ripe and canned as soon as possible.

The pineapples packed in the eastern part of the United States are imported from Cuba and other Caribbean Islands, and must necessarily be shipped somewhat green. Since they ripen in transit, they do not have as fine a flavor as fruit harvested ripe. They are graded according to three sizes.

No. 1 all over 5 inches in diameter. No. 2 all under 5 inches and over 3⅞ inches. No. 3 all under 3⅞ inches.

If the fruit is grown near the canning plants the tops are removed before packing in boxes, but if they are shipped any distance the tops are not removed until ready to undergo the preparatory process. This precaution is taken to prevent fermentation and spoilage.

After the removal of the tops, the fruit is conveyed to a machine which automatically peels, cores, and trims the top and bottom in one operation, after which it is conveyed to trimmers who trim any remaining skin or eyes before they are cut into half-inch slices.

As pineapple contains a proteolytic enzyme called bromelin which attacks the skin it is necessary that the operators use rubber gloves to protect their hands.

The slices are passed along belts where the perfect ones are selected and packed as "extras." The slightly imperfect packed as "standards," and the broken or half slices are packed and sold as such. Any remaining pieces are passed through a grater or slicer and packed as "grated."

The cores may be sliced into one-half-inch discs and candied for fruit cake, plum pudding, or mincemeat, or grated for pies, used for crushed fruit or pressed to recover the juice which is sold for syrups.

The skin or peeling which has been removed in two segments is passed through a machine known as an eradicator which removes any portion of the fruit inside the shell, due to thick peeling, after which the pulp is inspected to remove any pieces of skin or eyes. The pulp and other pieces of broken pineapple are then run through a grater and packed in water or syrup and sold for crushed fruit.

All the trimmings are run through rolls similar to sugar mill rolls which express the juice. The residue is either sent back to the farm, where it is ploughed under or dumped as refuse being entirely too high in moisture to be successfully burned. Some plants ferment the sugar remaining in the waste, and distill to recover the alcohol which can be used for vinegar or fuel. Pineapple vinegar can be made from the juice, but must be concentrated before being fermented because the sugar content is too low to make a vinegar that will comply with standards.

The expressed juice contains citric acid, albumin, pulp, and sugar. Usually milk of lime is added to almost neutralize all the citric acid, and then heated to near the boiling point to coagulate the albumin and cause it to precipitate. The juice

Trimming pineapple after the fruit has left the ingenious machine which removes shell and core, leaving fruit as shown.

is then subjected to bone char to clarify and remove any coloring matter, and then filtered. This juice with sugar added is then used to fill the cans of pineapple. By using this syrup considerable sugar can be saved. This juice is also bottled and canned and used for soda fountain syrup. The sludge or residue, being mostly calcium citrate, may be treated to recover the citric acid.

Pineapple, like apple, contains air which is removed by a vacuum process before adding the syrup. In syruping sliced pineapple usually about a 50° Brix syrup is used for high grade.

The cans are next exhausted at 140 to 150° F. sealed and processed at 212° F. for 15 minutes for No. 2½. Then they are immediately cooled to prevent further heating as this affects the flavor and color.

Styles of Canned Pineapple

Slices (Whole) of pineapple consist of whole, practically unbroken slices that have been cut at right angles to the axis into approximately equal units.

Half Slices of pineapple are portions of whole slices that are so matched in size and thickness that two halves are approximately equivalent to a slice.

Broken Slices of pineapple consist of portions of slices of the same thickness and diameter.

Crushed Pineapple is pineapple that has been cut or crushed into fine pieces.

Tidbits of pineapple are small, wedge-shaped sections cut from slices of pineapple.

Chunks are pieces of pineapple which need not be symmetrical nor uniform in size, but do not exceed 1½ inches in any dimension.

SYRUP DENSITY:—Pineapple is usually packed in syrup or a combination of syrup and pineapple juice. Syrup "cut-out" requirements, however, are not incorporated in the grades of the finished product since syrup, as such, is not a factor for the purpose of these grades.

"Extra heavy syrup" means that the syrup tests 22° or over, Brix.

"Heavy syrup" means that the syrup tests 18° to 22° Brix.

"Light syrup" means that the syrup tests 15° to 18° Brix.

"Water, or juice, slightly sweetened" means that the syrup tests less than 15° Brix.

"Juice pack" means that the product is packed in pineapple juice.

"Water pack" means that the product is packed in water.

Fill of Container and Recommended Drained Weight

The container shall be filled with pineapple as full as practicable without impairment of quality. The product and packing medium shall occupy not less than 90% of the total volume capacity of the container.

Drained weights of canned pineapple shall be determined by emptying contents of the can or glass container so as to distribute the product evenly upon a circular sieve 8 inches in diameter, with solid vertical walls sufficiently high to hold the contents, and draining for exactly 1 minute. The bottom of the sieve shall contain 6 meshes to the inch and shall be made with 3360 micron (No. 6) woven wire cloth which complies with the "Standard Specifications for Sieves" published by the U. S. Department of Commerce.

Recommended Minimum Drained Weights—Pineapple

Container size	Recommended Minimum Drained Weights (in ounces) Half Slices Broken Slices	Crushed	Tidbits Chunks
N. 2	13	14	13
No. 2½	18	20½	19
No. 10	65	..	68
No. 10 "Solid Pack"	..	98	..

Number of slices per container and approximate thickness and diameter of slices are shown in the following table.

Minimum Number Slices (Whole) and Half Slices

Container Size	Whole Slices Per Can	Half Slices Per Can	Approximate Thickness of Slices	Minimum Diameter of Slices	Approximate Diameter of Core Holes Minimum	Maximum
No. 2	10	20	⅜ in.	3½ in.	1 1/16 in.	1⅜ in.
No. 2½	8	16	½ in.	3¾ in.	1¼ in.	1⅜ in.
No. 10	50	..	⅜ in.	3⅛ in.	1 1/16 in.	1⅜ in.
No. 10	28	..	½ in.	3¾ in.	1¼ in.	1⅜ in.

Suggested Label Weights (Net Weight)

Pineapples		Lbs.	Ozs.
In syrup			
8Z Tall	211 x 304	.	9
No. 1 Flat	307 x 203	.	9
No. 211 Cylinder	211 x 414	.	14
No. 1¼ (Fancy Sliced)	401 x 207.5	.	15
No. 1¼ (Choice Sliced)	401 x 207.5	.	14½
No. 2	307 x 409	1	4
No. 2½ (Except Broken Slices)	401 x 411	1	14
No. 2½ (Broken Slices)	401 x 411	1	13
No. 10 (Except Crushed and Broken Slices)	603 x 700	6	12
No. 10 (Broken Slices)	603 x 700	6	11
No. 10 (Crushed)	603 x 700	6	13
In juice or water			
8Z Tall	211 x 304	.	8½
No. 1 Flat	307 x 203	.	9
No. 1¼ (Sliced)	401 x 207.5	.	14½
No. 2	307 x 409	1	4
No. 2½	401 x 411	1	13
No. 10 (Except Crushed)	603 x 700	6	10
No. 10 (Crushed)	603 x 700	6	11

PLUMS (Prunus Domestica)

Under the head of Green Gage and egg plums will be included all light colored plums and also the thin-skinned red ones. The fruit is sorted for size, washed, filled into plain cans or glass containers, and syrup or water added, exhausted 9-10 minutes in water exhaust at 200° and processed. A slow increase in the temperature will not cause the fruit to break. Sometimes they are pricked with copper wire to prevent bursting of the skin.

Process No. 2½ cans for 14 minutes at 212° F., and No. 10 can for 29 minutes at 212° F. For plums with large seeds process 2½'s 18 minutes, and 10's 40 minutes at 212° F.

Styles of Canned Plums

Halved canned plums are unpeeled, pitted plums, cut approximately in half along the suture from stem to apex.

Whole canned plums are whole, unpeeled, unpitted plums.

SYRUP DENSITY:—Grades A, B and C of plums are usually packed in syrup. Syrup "cut-out" requirements, however, are not incorporated in the grades of the finished product since syrup is not a factor for the purpose of these grades.

"Extra heavy syrup" means that the syrup tests 26° or more, but not more than 35° Brix.

"Heavy syrup" means that the syrup tests 21° to 26° Brix.

"Light syrup" means that the syrup tests 16° to 21° Brix.

"Water, slightly sweetened" means that the syrup tests less than 16° Brix.

"Water pack" means that the product is packed in water.

Recommended Fill of Container and Drained Weight

It is recommended that the container be filled with plums as full as practicable without impairment of quality and that the product and packing medium occupy not less than 90% of the volume capacity of the container.

Drained weights of canned plums are determined by emptying the contents of the container upon a circular sieve of proper diameter containing 8 meshes to the inch (0.097-inch square openings) and allowing to drain for 2 minutes. A sieve 8 inches in diameter is used for No. 2½ size containers and smaller, and a sieve 12 inches in diameter is used for containers larger than No. 2½ size.

Recommended Minimum Drained Weights—Plums

Container size or designation	Minimum drained weight (in ounces) Metal containers Halved	Whole	Glass containers Halved	Whole
8 oz. Tall	4¾	4¼	....	....
No. 1 Tall	9¾	9¼	....	....
No. 303 Glass	....	....	9¾	9¼
No. 2	12	11½	....	....
No. 2½ Glass	....	....	16¼	15½
No. 2½	17½	16½	....	....
No. 10 (Grades A, B, C, D, and E, in any syrup and "water, slightly sweetened")	64	60	....	....
No. 10 (Grades A, B, C "water pack")	64	60	....	....
No. 10 (Grades D and E "water pack")	72	65	....	....

Suggested Label Weights (Net Weight)

Plums		Lbs.	Ozs.
Fancy (Sp. Gr. 1.10)			
8Z Tall	211 x 304	.	8¾
No. 1 Tall	301 x 411	1	1
No. 303	303 x 406	1	1
No. 2	307 x 409	1	5
No. 2½	401 x 411	1	14
No. 10	603 x 700	6	14
Choice (Sp. Gr. 1.08)			
8Z Tall	211 x 304	.	8¾
No. 1 Tall	301 x 411	1	.
No. 303	303 x 406	1	.
No. 2	307 x 409	1	4
No. 2½	401 x 411	1	14
No. 10	603 x 700	6	12

Standard (Sp. Gr. 1.06)			
8Z Tall	211 x 304	.	8½
No. 1 Tall	301 x 411	1	.
No. 303	303 x 406	1	.
No. 2	307 x 409	1	4
No. 2½	401 x 411	1	13
No. 10	603 x 700	6	10
Seconds			
No. 2½	401 x 411	1	12
Water (Sp. Gr. 1.04)			
No. 2	307 x 409	1	3
No. 2½	401 x 411	1	12
No. 10	603 x 700	6	8

PRUNES

Only clean, sound prunes of good quality should be used. After washing thoroughly in cold water they are then blanched for from 5 to 10 minutes in boiling water. They are packed into plain, or charcoal plate cans or clear glass containers. Enameled cans swell more rapidly than coke plate cans and charcoal plate cans swell more slowly than coke plate cans. The following amounts of blanched prunes should be used:

Size of Container	Net Amount of Prunes
4 ounces	1½ to 2 ounces
8 ounces	3 to 4½ ounces
No. 1 tall	7½ to 8½ ounces
No. 2 tall	8½ to 10 ounces
No. 2½	13 to 15 ounces
No. 10	3 to 3¼ pounds

It is not advisable to fill the can to the top with syrup but to leave a fair head space.

The following head space should be used to obtain the best results:

Size of Containers	Depth of Head Space
8 ounces	¼-inch
No. 1 tall	5/16-inch
No. 2 tall	⅜-inch
No. 10	½-inch

It has been found that the swelling was minimized by using larger head space.

Containers are then filled with a hot sugar syrup of 15-20% and exhausted in a steam box from 15 to 20 minutes at 190°-210° depending upon the size of the can. It should be sealed immediately. They may then be sterilized for one hour at 212° F. in agitation cookers for all cans up to No. 2½ and one and one-half hours for No. 10 cans. The containers should immediately be cooled and then stored in a cool dry warehouse.

Canned dried prunes are the whole, ripe fruit of the plum tree (Prunes domestica) from which the greater portion of moisture was removed and which are subsequently processed, usually by rehydration in boiling water or steam; by packing with or without the addition of syrup, sugar, or a liquid medium; with or without the addition of a slight amount of edible acid; with or without the addition of a seasoning ingredient; and are sufficiently processed by heat to assure preservation of the product in hermetically sealed containers.

Types and Varieties of Canned Dried Prunes

Sweet Types include such varieties as French, Imperials, Sugar and Robe de Sergeant varieties.

Tart Type includes the Italian variety.

SYRUP DENSITY:—Dried prunes are usually packed in syrup, or other packing medium. Syrup "cut-out" requirements, however, are not incorporated in the grades of the finished product as syrup, as such, is not a factor of quality for the purpose of these grades.

"Extra heavy syrup" means that the syrup tests 30° or more Brix.

"Heavy syrup" means that the syrup tests 24° to 30° Brix.

"Light syrup" means that the syrup tests 18° to 24° Brix.

Syrup that tests less than 18° Brix is considered "Water pack."

Recommended Drained Weight

Drained weights of canned dried prunes are determined by emptying the contents of the container upon a circular sieve of proper diameter, containing 8 meshes to the inch (0.097-inch perforations) and allowing to drain for 2 minutes. A sieve 8 inches in diameter is used for No. 2½ size containers and smaller, and a sieve 12 inches in diameter is used for containers larger than No. 2½ size.

Recommended Minimum Drained Weights—Dried Prunes

Container Size or Name	Recommended Drained Weight		
	Metal Containers		Glass Containers
	Regular Pack	Heavy Pack	Regular Pack
8 ounces	5½ ounces		
No. 1 Tall	10¾ ounces		
No. 2	13 ounces		
No. 2½	19 ounces	29 ounces	18 ounces
No. 10	70 ounces	110 ounces	

Suggested Label Weights (Net Weight)

Prunes, Prepared (Sp. Gr. 1.10)		Lbs.	Ozs.
8Z Tall	211 x 304	.	8¾
No. 211 Cyl.	211 x 414	.	13½
No. 1 Tall	301 x 411	1	1
No. 303	303 x 406	1	1
No. 2	307 x 409	1	5
No. 2½	401 x 411	1	14
No. 10	603 x 700	6	14

QUINCES

The only demand for quinces is for the preserve trade so they are packed in No. 10 tins, and in order to obtain the maximum flavor they should be canned when ripe.

Irregular in shape like pears, they must be hand peeled. After peeling and trimming the fruit is placed in dilute salt solution to prevent discoloration. Containing entrapped air like apples, they are either vacuumized, blanched or handled the same as apples before packing into containers. Handle same as apples as to filling, exhausting and processing.

No. 1 can 10 minutes at 212° F. No. 2 can 10 minutes at 212° F. No. 3 can 12 minutes at 212° F. No. 10 can 18 minutes at 212° F.

There is steady demand for quince jelly, so that the peelings and cores can be utilized for jelly purposes. Cover the peelings with water and cook and either drain the extracted juice, or else press to obtain the maximum yield. Heat to boiling and fill immediately into hot five-gallon lacquered cans that have been taken from the steam jet. Cap and turn on their sides to sterilize the cap. Stack so they will cool as rapidly as possible.

RASPBERRIES (Rubus Occidentalis and Rubus Idaeus)

In order to aid in the preservation of the color and flavor it is necessary to add some sugar. Fancy grade of Red Raspberries is packed with a 60% sugar, Choice with a 40, Standard with a 20, Second grade with a 10, and Pie packed in water. Black Raspberries, Fancy Grade are packed in 40% sugar, Choice in 30%, Standard in 20%, and Pie in water. The syrup or water used to cover the fruit should be heated to 200° F. before adding.

Enameled cans or glass containers are used, otherwise the berries (especially the Cuthbert) will lose their color and bleach.

The fruit should be washed carefully and picked gently

Inspecting small fruit under germicidal lamps, which will inactivate mold and other organisms on fruit's surface.

to remove leaves, stems, shrivelled berries, etc. Due to the soft and ripe condition of red raspberries, it is almost impossible to wash the fruit without breaking it apart.

The berries are exhausted at 180° F. for 10 to 12 minutes. They are processed 10 to 12 minutes at 212° F. for No. 2 cans; and 14 to 15 minutes for No. 2½ cans, and for No. 10 tins 30 to 35 minutes.

SYRUP DENSITY:—Grades A, B, C, D of red raspberries are usually packed in sugar syrup. Syrup "cut-out" requirements, however, are not incorporated in grades of the finished product as syrup as such is not a factor for the purpose of these grades.

"Extra heavy syrup" means that the syrup tests 28° or over Brix.

"Heavy syrup" means that the syrup tests 22° to 28° Brix.

"Medium syrup" means that syrup tests 14°-22° Brix.
Brix.

"Light syrup" means that the syrup tests 11° to 14° Brix.

"Water pack" means that the packing media tests less than 11° Brix.

Recommended Head Space and Drained Weights

Drained weights of canned red raspberries are determined by emptying the contents of the can or glass container upon a circular sieve containing 8 meshes to the inch (0.097-inch perforations), and allowing to drain for 2 minutes. The sieve diameters used are: 8 inches for No. 2 size containers or smaller, and 12 inches for No. 10 size cans.

The maximum head space and minimum drained weight allowable in the cans commonly used in packing canned red raspberries are shown in the following table.

Container Size	Maximum capacity in water at 68° F. (in ounces)	Maximum head space allowable (measured from top of double seam in16ths of an inch)	Minimum drained weight (in ounces)
3" Buffet	7.93	7.2	4½
3¼" Buffet	8.68	7.6	5
No. 2	20.55	9.7	12
No. 10	109.43	13.6	63
No. 10 (Water Pack)	109.43	13.6	70

Suggested Label Weights (Net Weight)

Raspberries, Red		Lbs.	Ozs.
Fancy (Sp. Gr. 1.10)			
8Z Tall	211 x 304	.	8¾
No. 1 Tall	301 x 411	1	1
No. 303	303 x 406	1	1
No. 2	307 x 409	1	5
No. 2½	401 x 411	1	14
No. 10	603 x 700	6	14
Choice (Sp. Gr. 1.08)			
8Z Tall	211 x 304	.	8¾
No. 1 Tall	301 x 411	1	.
No. 303	303 x 406	1	.
No. 2	307 x 409	1	4
No. 2½	401 x 411	1	14
No. 10	603 x 700	6	12
Standard (Sp. Gr. 1.05)			
8Z Tall	211 x 304	.	8½
No. 1 Tall	301 x 411	1	.
No. 303	303 x 406	1	.
No. 2	307 x 409	1	4
No. 2½	401 x 411	1	13
No. 10	603 x 700	6	9
Water (Sp. Gr. 1.03)			
No. 1 Tall	301 x 411	1	.
No. 303	303 x 406	1	.
No. 2	307 x 409	1	3
No. 2½	401 x 411	1	12
No. 10	603 x 700	6	7
Raspberries, Black			
Fancy (Sp. Gr. 1.09)			
8Z Tall	211 x 304	.	8¾
No. 1 Tall	301 x 411	1	1
No. 303	303 x 406	1	1
No. 2	307 x 409	1	4
No. 2½	401 x 411	1	14
No. 10	603 x 700	6	13
Choice (Sp. Gr. 1.06)			
8Z Tall	211 x 304	.	8½
No. 1 Tall	301 x 411	1	.
No. 303	303 x 406	1	.
No. 2	307 x 409	1	4
No. 2½	401 x 411	1	13
No. 10	603 x 700	6	10
Standard (Sp. Gr. 1.05)			
8Z Tall	211 x 304	.	8½
No. 1 Tall	301 x 411	1	.
No. 303	303 x 406	1	.
No. 2	307 x 409	1	4
No. 2½	401 x 411	1	13
No. 10	603 x 700	6	9
Water (Sp. Gr. 1.02)			
No. 1 Tall	301 x 411	.	15½
No. 303	303 x 406	1	.
No. 2	307 x 409	1	3
No. 2½	401 x 411	1	12
No. 10	603 x 700	6	6

RHUBARB (Rheum Rhaponticum)

While rhubarb is a vegetable, it is considered a fruit by most people, being used similarly to fruits such as apples, cherries, etc. Consequently it has been placed with the fruits.

There is some demand for this product packed in No. 10 tins for pie trade. The yield is about 300 No. 10 cans per ton. On account of its high acidity and action on tin plate, it is apt to pinhole so that enameled cans are used with better success.

Cut the rhubarb into pieces about one inch long using a stock feed or string bean cutter. Blanch about two minutes,

chill and pack into containers. The rhubarb may be cut into lengths without peeling.

There are two other methods used in canning this product. The one is to soak the cut rhubarb in warm water at about 120° F. for several hours, then blanch several minutes if necessary, fill into containers, add hot water, exhaust, cap and sterilize. The other method is to soak the cut rhubarb over night in cold water to displace the oxygen, fill into containers, add hot water, exhaust, cap, and sterilize.

Soaking reduces the acidity somewhat and removes the oxygen which forms head space in containers and causes pinholing. Rhubarb being porous like apples contains entrapped oxygen which must be replaced by water so no head space will be found in the finished containers.

To offset the strong acidity, the product is often packed in a 50° Brix syrup instead of water. Exhaust No. 3 containers 3 minutes at 212° F., or 12 minutes at 180° F. Enameled cans or glass containers are used, although the enamel of the can eventually peels off. Exhaust No. 10 cans for 8 minutes at 212° F. Sterilize No. 3 cans for 2 to 5 minutes at 212° F. Sterilize No. 10 cans for 4 to 5 minutes at 212° F. Cool well before stacking. Rhubarb should not be held for more than six to eight months in cans because it forms hydrogen swells.

STRAWBERRIES (Fragaria Virginiana)

Only firm, sound fruit of good color and flavor should be canned. Lacquered cans or glass containers are used, as they preserve the color. Strawberries, when canned, are one of the poorest fruits, because of the loss of color and flavor.

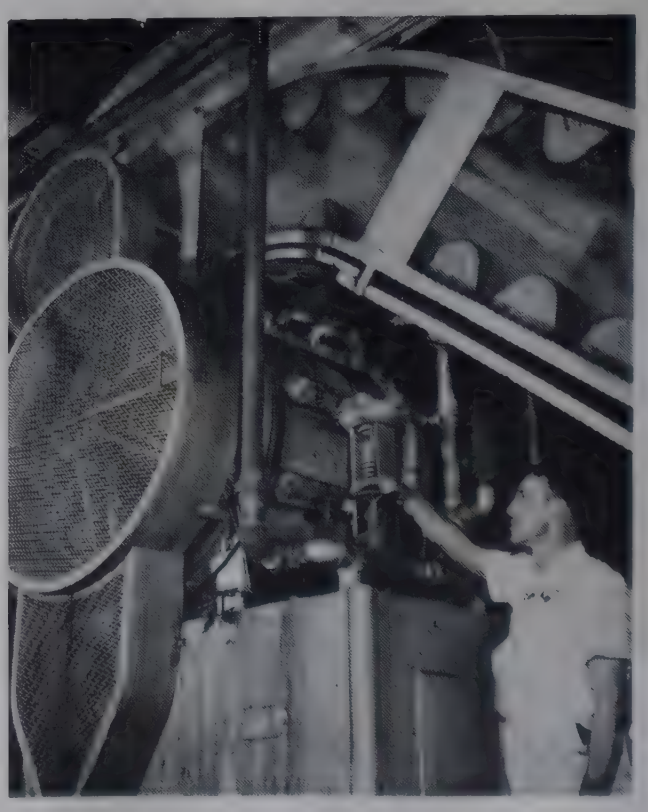
Fruit is washed, stemmed or capped and packed solid into containers and covered with hot 60% syrup for Fancy, 40% for Choice, 20% for Standard, 10% for Second Grade, and water for Pie Grade. Because strawberries absorb sugar syrup slowly, they are floaters. If containers are inverted at the end of twenty-four hours after being processed, more of the sugar will be absorbed. Exhaust 2's 5 to 8 minutes and 10's 9 to 15 minutes at 200° F. Cook 2's temperature at center 140° F. Water pack 8 minutes at 212° F., 20° syrup 10 minutes, 40° syrup 15 minutes and 60° syrup 18 minutes. Cook 10's temperature in center 140° F., Water pack 20 minutes at 212° F., 20° syrup, 22 minutes, 40° syrup 28 minutes and 60° syrup, 30 minutes. Cool thoroughly in cold water.

Wherever cold storage facilities can be obtained, the packing of canned strawberries should be discouraged and the fruit cold packed. When canning must be resorted to, about 50% Brix syrup gives the best results. Upon standing any length of time, the canned fruit loses its bright red color and flavor, becoming somewhat soft and "flabby" with a grayish red color. Even the syrup does not have the brilliant color as it invariably changes to a somewhat pale cloudy red.

Suggested Label Weights (Net Weight)

Strawberries		Lbs.	Ozs.
Fancy (Sp. Gr. 1.09)			
8Z Tall	211 x 304	.	8¾
No. 1 Tall	301 x 411	1	1
No. 303	303 x 406	1	1
No. 2	307 x 409	1	4
No. 2½	401 x 411	1	14
No. 10	603 x 700	6	13
Choice (Sp. Gr. 1.08)			
8Z Tall	211 x 304	.	8¾
No. 1 Tall	301 x 411	1	.
No. 303	303 x 406	1	.
No. 2	307 x 409	1	4
No. 2½	401 x 411	1	14
No. 10	603 x 700	6	12
Standard (Sp. Gr. 1.05)			
8Z Tall	211 x 304	.	8½
No. 1 Tall	301 x 411	1	.
No. 303	303 x 406	1	.
No. 2	307 x 409	1	4
No. 2½	401 x 411	1	13
No. 10	603 x 700	6	9
Water (Sp. Gr. 1.02)			
No. 1 Tall	301 x 411	.	15½
No. 303	303 x 406	1	.
No. 2	307 x 409	1	3
No. 2½	401 x 411	1	12
No. 10	603 x 700	6	6

Mechanical dumping of fruit lugs.



Steam-chemical unit removes skin in seconds.

Chapter III—Canning of Vegetables

ALL processing temperatures and times in this chapter are the most recent recommendations of the National Canners Association Research Laboratory, Washington, D. C. The recommendations are from Bulletins 26-L and 30-L respectively titled "Processes for Low-Acid Canned Foods in Metal Containers" and "Processes for Low-Acid Canned Foods in Glass Containers."

Information relating to types, styles, drained weights, counts, and sizes for each commodity is from the latest standards of the Production and Marketing Administration, United States Department of Agriculture.

ASPARAGUS (Asparagus Officinalis)

While a small amount of asparagus is grown and packed in New York, New Jersey, Pennsylvania, Maryland, and Illinois, most of it is packed in California where the soil and climate conditions are ideal. The asparagus packed in the East usually contains green tips while the California pack is grown to provide a product with a bleached appearance.

In the West the plants are sometimes covered with soil during the growing period. They are not bleached but it does not permit the chlorophyl to develop during the growing period. By forming ridges or hillocks about 15 to 18 inches high with the soil, the young stalks are kept covered. Just as the tip of the stalks break through the soil, they are cut about 8 to 10 inches below the surface by means of long-handled chisels, or if the green variety, 1 to 2 inches below the surface.

The asparagus is handled as expediently as possible to prevent wilting, development of bitterness and toughness. The stocks are washed to remove dirt and prevent wilting and then cut to uniform length by placing upon racks with all of the tips lying in the same direction and then cutting off the butt ends with a knife. Washing cools the stalks and prevents deterioration. The asparagus is sorted for size, color, and quality before blanching; the different grades being handled separately.

Until recently, asparagus was graded entirely by hand but now mechanical graders are being used efficiently in many factories. Mechanical grading is cheaper and faster. As the asparagus passes along a conveyor belt, defective stalks are removed by inspectors who also straighten the spears so that the will be lined up evenly before the butt ends are removed by passing through revolving cutting blades. The asparagus is firmly held as it passes through the cutters or is placed in boxes and weighed as it is cut. Next the asparagus is fed lengthwise to the grader, which consists of round rubber belts that spread or have greater space between them as the distance from the inlet becomes greater. This allows the thinner asparagus to fall through first but the larger in diameter passes on until it reaches the proper space and then it falls through into wicker or bamboo baskets. Next the baskets are lowered into a tank of cold water and then into another tank of hot water for from 6 to 7 minutes after which the asparagus is chilled by immersing into a tank of cold water. Some may use continuous washers and blanchers, which, save considerable time and labor.

Add a hot salt brine, made by dissolving eight pounds of salt in 40 gallons of water. Exhaust from 6 to 8 minutes at 190° F. for small containers and 200-205° F. for large containers. Seal and process.

Recommended Processing Temperatures and Times—Asparagus, white and white-green

Container Size	Dimensions	Retort temperature Deg. F.	Time (a) Tips up Min.	Time (a) Tips down Min.
8Z Tall.....	211x304	240	27	25
No. 1 (Picnic)....	211x400	248	19	16
		240	27	25
		248	19	16
No. 1 Tall.....	301x411	240	27	25
		248	19	16
No. 2 (b).....	307x409	240	27	25
		248	19	16
No. 1 Square.....	300x308x308	240	27	25
		248	19	16
No. 2½ Square...	300x308x604	240	27	25
		248	19	16
No. 2½.....	401x411	240	27	25
		248	19	16

(a) Two series of processing times are shown in the last two columns, headed tips up and tips down, respectively. These headings refer to the position of the spears in the retort during processing. Processing the cans in a vertical position is very important.

(b) Cans of No. 2 diameter but of other lengths than 409 should be given the same processes as the standard No. 2 can.

Asparagus, all green (a)

Container Size	Dimensions	Retort temperature Deg. F.	Time Tips up Min.	Time Tips down Min.
8Z Tall.....	211x304	240	27	27
		248	19	17
No. 1 (Picnic)....	211x400	240	27	27
		248	19	17
No. 1 Tall.....	301x411	240	27	27
		248	19	17
No. 2 (b).....	307x409	240	27	27
		248	19	17
No. 1 Square.....	330x308x308	240	27	27
		248	19	17
No. 2½ Square...	300x308x604	240	27	27
		248	19	17
No. 2½.....	401x411	240	27	27
		248	19	17

(a) Two series of processing times are shown in the last two columns, headed tips up and tips down, respectively. These headings refer to the position of the spears in the retort during processing. Processing the cans in a vertical position is very important.

Asparagus cuts, white and green, including soup cuts

Container Size	Dimensions	Retort temp.	Time Min.
8Z Tall	211x304	240	25
		248	15
No. 1 (Picnic).....	211x400	240	25
		248	15
No. 1 Tall.....	301x411	240	25
		248	15

No. 2	307x409	240	25
		248	15
No. 2½	401x411	240	25
		248	15
No. 10	603x700	240	30
		248	18

Types of Canned Asparagus

Culturally Bleached asparagus is asparagus so cultivated that the development of chlorophyll is inhibited in all or in part of the units.

"White asparagus" is practically all white or yellow-white.

"Green-tipped asparagus" possesses yellow-green, green, or purple heads and includes asparagus with portions of the stalks similarly colored or with light colored or white stalks.

Green or All Green asparagus is green or yellow-green the entire length of the unit.

Suggested Label Weights (Net Weight)

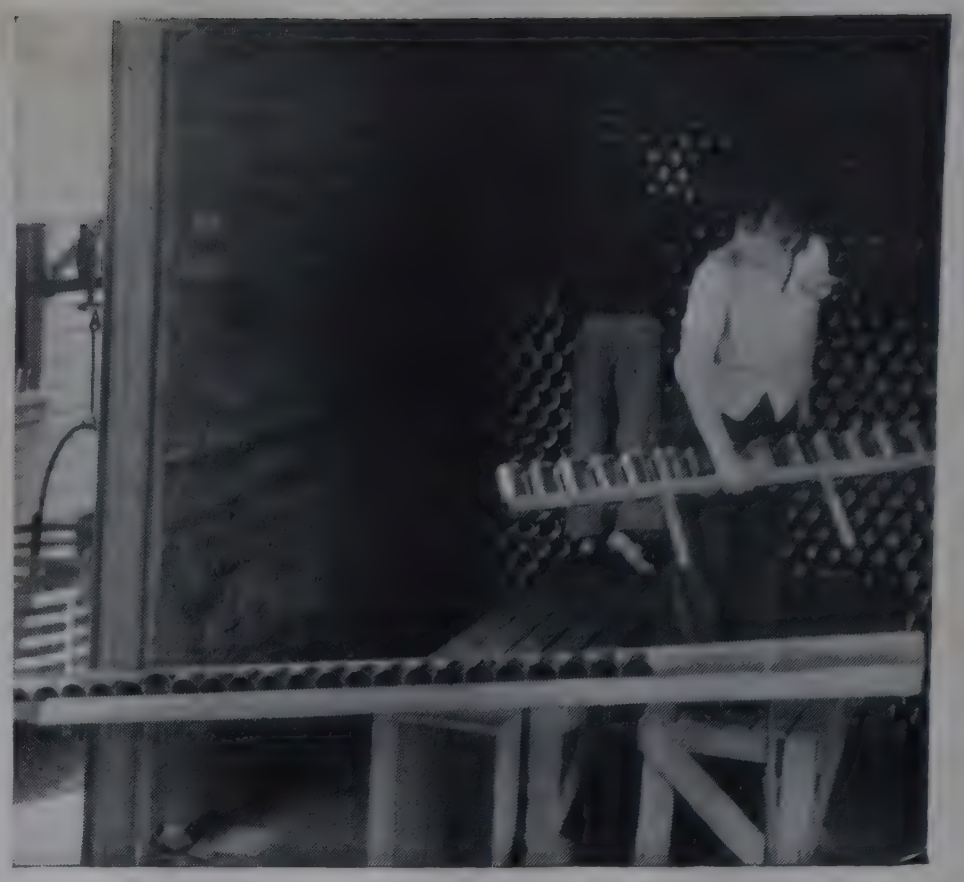
Asparagus (Sp. Gr. 1.03)		Lbs.	Ozs.
8Z Tall	211 x 304	.	8¼
No. 1 Picnic	211 x 400	.	10½
No. 300	300 x 407	.	14½
No. 1 Tall	301 x 411	1	.
No. 303	303 x 406	1	.
No. 2	307 x 409	1	3
Jumbo	307 x 510	1	8
No. 2½	401 x 411	1	12
No. 3 Cylinder	404 x 700	3	.
No. 10	603 x 700	6	7
Asparagus Tips			
Same weights as Asparagus.			
Asparagus, Cut Stalks (Sp. Gr. 1.01)		**Lbs.**	**Ozs.**
8Z Tall	211 x 304	.	8
No. 1 Picnic	211 x 400	.	10
No. 300	300 x 407	.	14
No. 1 Tall	301 x 411	.	15½
No. 303	303 x 406	.	15½
No. 2	307 x 409	1	3
Jumbo	307 x 510	1	7
No. 2½	401 x 411	1	12
No. 3 Cylinder	404 x 700	3	.
No. 10	603 x 700	6	5

Minimum Drained Weights

Can size	Can dimensions (in inches)		Minimum drained weight (in ounces) CUT STALKS or CUT SPEARS (All sizes) STALKS or SPEARS (Small, medium, or large or blended sizes with counts within limits for such sizes)		STALKS or SPEARS (Extra large sizes or blended sizes with counts within limits for extra large size)	
	Diameter	Height	Culturally Bleached	All Green	Culturally Bleached	All Green
No. 1 P	2 11/16	4	7	6½	6¾	6¼
No. 300	3	4 7/16	10	9	9½	8½
No. 2	3 7/16	4 9/16	13½	12¼	12¾	11¾
No. 1 sq.	3x3 3/16	3 3/16	12	11	11½	10½
No. 2½ rd.	4 1/16	4 11/16	19½	17¾	..	..
No. 2½ sq.	3x3 3/16	6 4/16	22	20	21	19
No. 10	6 3/16	7	68	63	..	..

Count and Size

Size	Approximate diameter of base of spears	Range of number of spears, tips, or points per container: No. 1P	No. 300	No. 2	No. 1 Square	No. 2½ Square
No. 1 (Small)	3/8 in.	31-40	39-51	51-67	61-80	45-60
No. 2 (Medium)	½ in.	23-30	26-38	34-50	41-60	35-44
No. 3 (Large)	5/8 in.	17-22	19-25	25-33	31-40	25-34
No. 4 (Extra large)	7/8 in. & over	7-16	9-18	12-24	13-30	12-24



Bulk cans being unloaded from freight car by conveyor system.

Styles of Canned Asparagus

Canned asparagus may be **Peeled or Unpeeled.**

Stalks or Spears consist of the head and adjoining portions of the stalks, are packed parallel as closely together as practicable without injury to the product, are not less than 3¾ inches in length, and approximate in length the inside height of the can.

Tips are packed in the same manner as spears and are less than 3¾ inches but not less than 2¾ inches in length.

Points are tops of spears and are less than 2¾ inches in length.

Cut Stalks or Cut Spears are spears or stalks which have been cut into pieces without removal of heads or addition of bottom cuts. If cut in lengths of 1¼ inches or less, the product usually contains not less than 25 per cent by count of heads. If cut in pieces longer than 1¼ inches, the product usually contains not less than 33⅓ per cent by count of heads. Federal inspection, certificates shall indicate the percentage of heads found upon examination.

Bottom Cuts or Cuts—Tips Removed are edible spears with heads removed which have been cut into pieces.

Retort crates passing by monorail through cooling tank.

SNAP GREEN AND WAX BEANS (Phaseolus Namus)

Beans grow well in any climate that is adapted to the growth of peas. They too are a valuable addition to the varied list of vegetables both fresh and processed. When properly prepared in the home and factories, the vitamins which they contain are not destroyed.

Beans are grown and canned principally in parts of New York, Maryland, Maine, Wisconsin, Michigan, California, and Colorado.

They should be picked when they have reached the proper maturity and delivered to the factory as soon as possible, using baskets, boxes, or lugs, but never in bags otherwise the beans may "sweat," become moldy, tough and woody.

By special growth, development and selection, the stock grown has improved so that a more delicate and finer bean has resulted without the coarse tough string. This has almost eliminated stringing by hand, and in some plants they are handled almost automatically from the time of their arrival until they are packed in containers.

Upon arrival at the factory, the beans are automatically graded for size and run through other machines to "snip" or cut off the ends before they pass through the cutter which also automatically cuts them to the desired length of about one inch. After this preparation, they are washed to remove any extraneous material and to freshen.

The beans are blanched for 5 minutes in boiling water after which they are chilled in cold water or by spraying. Drain and pack into cans.

Machines have been made which eliminate hand filling. The blanched beans are placed in a hopper having large openings in the bottom and by rapid shaking the beans are distributed to the cans in trays.

They are then covered with a dilute hot salt brine made by dissolving one pound of salt in eight gallons of water.

Chutes deliver beans to cutting machines for automatic cutting to desired lengths. Washers are directly behind cutters.

Recommended Processing Temperatures and Times

Beans, green or wax, whole or cut

Can name	Dimensions	Retort temperature Deg. F.	Time Min.
8Z Tall	211x304	240	20
No. 1 (Picnic)	211x400	240	20
No. 303	303x406	240	20
No. 2	307x409	240	20
No. 2½	401x411	240	25
No. 10	603x700	240	35

Beans, green or wax, asparagus style

8Z Tall	211x304	240	25
No. 1 (Picnic)	211x400	240	25
No. 303	303x406	240	25
No. 2	307x409	240	25
No. 10	603x700	240	45

Beans, green or wax, Julienne or French Style

Can name	Dimensions	Retort temperature Deg. F.	Min. Time	Maximum drained weight Oz.
No. 2	307x409	240	25	14 oz.
No. 10	603x700	240	45	70 oz.

(a) These processes apply only to beans that are properly blanched.

(b) For the packing of bean "nubbins," consult a research laboratory connected with the canning industry.

(c) All containers of asparagus style beans are processed in a position such that the beans are upright in the retort.

Beans, green or wax, whole or cut

Jar size	Dimensions	Retort temperature Deg. F.	Time Min.
No. 303	303x411	240	25
No. 2½	401x414	240	30

Types of Canned Beans

Round Type canned green or wax beans are canned beans consisting of round type beans having a width not greater than 1½ times the thickness of the bean.

Flat Type canned green or wax beans are canned beans consisting of flat type beans having a width greater than 1½ times the thickness of the bean.

Styles of Canned Beans

Whole—means canned beans that are not arranged in any definite position in the container.

Whole Vertical Pack—means canned beans that are packed parallel to the sides of the container.

Whole Asparagus Style—means canned beans consisting of pods that are cut at both ends, are of substantially equal lengths, and are packed parallel to the sides of the container.

Sliced Lengthwise or French Style—means canned beans consisting of pods that are sliced lengthwise.

Cut or Cuts—means canned beans consisting of pods that are cut transversely into pieces less than 2¾ inches, but not less than ¾ inch, in length, and may contain shorter end pieces which result from cutting.

Short Cut or Short Cuts—means canned beans consisting of pieces of pods of which not less than 75% are less than ¾ inches in length, and not more than 1% are more than 1¼ inches in length.

Mixed or Mixture—means a mixture of two or more of the

following forms of canned beans: "Whole", "Sliced Lengthwise", "Cuts" or "Short Cuts".

Suggested Label Weights (Net Weight)

Beans, Green and Wax (Sp. Gr. 1.01)		Lbs.	Ozs.
8Z Tall	211 x 304	.	8
No. 1 Picnic	211 x 400	.	10
No. 1 Tall	301 x 411	.	15½
No. 303	303 x 406	.	15½
No. 95	307 x 400a	1	.
No. 2	307 x 409	1	3
No. 2½	401 x 411	1	12
No. 10	603 x 700	6	5

Recommended Minimum Drained Weights (in ounces)

Container size or designation	Whole	Vertical Pack or Whole Asparagus Style	Short Cuts and Cuts less than 1½ inches	French Style and Cuts 1½ inches and longer
No. 1 (E)	6⅛	..	6⅜	..
No.1 Tall	9⅜	..	9¾	..
No. 300	8½	..	8⅞	.
No. 303	9½	..	9⅞	..
No. 2	11½	12½	12	11½
No. 2½	16¾	18	17½	16¾
No. 10	61	..	65	63

BEANS, LIMA (Phaseolus Lunatus)

The dwarf or bush variety is used mostly in canning. The vines are cut close to the ground, harvested the same as peas by hulling through a pea viner. It may be necessary to run them through several times to obtain proper separation. The screens used are different and the machine not operated as rapidly as for peas.

After thrashing, they are cleaned by passing through a pea cleaner and then through a sorter for size. They are again hand picked to remove any defective beans, pods, and foreign matter. The packers also sort the green ones from the more mature by floating in salt brine. They are sorted according to sizes and standards.

Blanch in boiling water from 4 to 6 minutes, using small wire baskets and then soak in cold water to remove the bitter taste. Fill containers to within ¾ of an inch of the top. Some fill with automatic fillers, but due to their size and shape, this is not advised as too many are cut and mashed by the valves. Cover with a 2-2.5% salt brine.

The larger white and yellow lima beans are more mature and usually harder and require soaking in water several hours before blanching. Blanch them from 12 to 15 minutes or until they feel "spongy" when rolled between the thumb and fingers. Then spray with cold water to remove any starchy material so the liquor will not be cloudy. Fill containers and cover with a hot 2½% salt brine.

SOAKED LIMA BEANS:—These beans are packed from dried beans. Use either small or medium stock. The canned fresh lima beans have replaced this product due to the labeling that the food laws have required. Whenever this product is packed, it should be labeled properly, using the same size, type, stating it is "Soaked Dry Lima Beans."

Place them in tanks or barrels and cover with boiling water, allow them to stand 3 to 4 hours, then draw off the water and cover with cold water, soaking 12 to 15 hours longer. When the water is cold, the chill can be removed before using it.

Some have used thickeners in packing soaked beans, but if used should be so declared on the label. Wheat flour is preferable, as it will not produce a scorched taste after processing.

Here are inspection tables where various sizes and grades of whole snap beans get first inspection before cutting.

In making a thickener, use 5 pounds of flour or 4 pounds of corn starch, mix the flour in about 4 gallons of a 2½% salt solution. Keep it well stirred during the process of filling, or it can be cooked slightly with live steam to keep the flour or starch from settling. The beans should not need thickeners because they disintegrate in processing, and the bean starch will thicken the liquor.

Definition

Canned Lima Beans are the canned vegetables prepared from the immature seed of varieties of the South American lima bean (Phaseolus lunatus) by shelling and thorough washing; with or without grading for size; precooking (blanching); and by the addition, before sterilization, of the necessary quantity of potable water; with or without salt; with or without sugar; packed in hermetically sealed containers, and sterilized by heat.

Recommended Processing Temperatures and Times

Beans, shelled types, including limas

Can name	Dimensions	Retort temperature Deg., F.	Time Min.
No. 1 (Picnic)	211x400	240	35
		245	25
		250	18
No. 300	300x407	240	35
		245	25
		250	18
No. 1 Tall	301x411	240	35
		245	25
		250	18
No. 303	303x406	240	35
		245	25
		250	18
No. 2	307x409	240	35
		245	25
		250	18
No. 10	603x700	240	55
		245	40
		250	80

Beans, Lima, succulent

Jar size	Dimensions	Retort temp. Deg. F.	Time Min.
No. 303	303x411	240	45

Beans, mature, and soaked dried legumes, shelled types in unthickened sauce

Jar size	Dimensions	Retort temperature Deg. F.	Time Min.
No. 303	303x411	240	60
No. 2½	401x414	240	65

Minimum Drained Weight:—No. 1 (Picnic)—7 ozs., No. 303—11 ozs., No. 2— 13½ ozs., No. 10—72 ozs.

Suggested Label Weights (Net Weight)

Beans, Lima (Sp. Gr. 1.05)		Lbs.	Ozs.
8Z Tall	211 x 304	.	8½
No. 1 Picnic	211 x 400	.	10½
No. 1 Tall	301 x 411	1	.
No. 303	303 x 406	1	.
No. 2	307 x 409	1	4
No. 3 Cylinder	404 x 700	3	2
No. 10	603 x 700	6	9

Sizes of Lima Beans

The score for this factor is based upon the conformity of the beans to the size claimed for them. When green lima beans are graded for size, the following nomenclature is descriptive of the various sizes.

Midget size green lima beans are beans that will pass through a sieve containing 28/64-inch perforations and may be known as No. 1 size.

Tiny size green lima beans are beans that will pass through a sieve containing 30/64-inch perforations, but will not pass through a sieve containing 28/64-inch perforations, and may be known as No. 2 size.

Small size green lima beans are beans that will pass through a sieve containing 34/64-inch perforations, but will not pass through a sieve containing 30/64-inch perforations, and may be known as No. 3 size.

Medium size green lima beans are beans that will not pass through a sieve containing 34/64-inch perforations, and may be known as No. 4 size.

Glass packed beets moving from vacuum sealing machine to an accumulating table prior to crating for the retort operation.

BEETS (Beta Vulgaris)

The small red beets are used for canning and may be graded into sizes by passing through a revolving grader which also removes some of the dirt. Some use the Detroit Dark Red variety because of their round, uniform shape with a dark red color, even texture and excellent flavor. When harvesting the beets it is well to leave a little of the top on to prevent excessive bleeding. They are soaked in water to loosen and remove the soil and sprayed before steaming to remove the skin.

Place the washed beets in wooden trays or process baskets lined with wood to prevent discoloration, which would result from contact with an iron basket. Then place in retorts and steam to 220° F. until the skin is easily removed. This will require about 20 minutes for small sizes and 25 for large ones. Some peel the beets by blanching in water, but this method causes the beet to "bleed" and lose color; others use a pea blancher requiring 8 to 10 minutes in boiling water. The beets may be peeled mechanically by using a vegetable peeler.

Trim the top and root end and place them in water to conserve the color until packed in enameled cans or jars. Cover with dilute salt brine (6 pounds of salt in 40 gallons of water) or hot water, exhaust, cap, and process.

CUT BEETS:—After peeling, beets are sliced about ⅜ of an inch thick. Fill into containers, exhaust and process.

Recommended Processing Temperatures and Times

Beets, whole, cut, diced, sliced, or shoestring

Can name	Dimensions	Retort temperature Deg. F.	Time Min.
8Z Tall	211x304	240	30
No. 1 (Picnic)	211x400	240	30
No. 303	303x406	240	30
No. 2	307x409	240	30
No. 2½	401x411	240	30
No. 10, except sliced	603x700	240	40
No. 10, sliced	603x700	240	45

Beets, whole, cut, quaratered, diced, sliced, or shoestring

Jar size	Dimensions	Retort temperature Deg. F.	Time Min.
No. 303	303x411	240	35
No. 2½	401x414	240	40

Style of Canned Beets

Whole or Whole Beets means canned beets consisting of whole beets that retain the approximate original conformation of the whole beet.

Slices or Sliced Beets means canned beets consisting of slices of beets irrespective of whether such slices are "Corrugated," "Fluted," "Wavy," or "Scalloped."

Quarters or Quartered Beets means canned beets consisting of quarters of beets.

Dice or Diced Beets means canned beets consisting of diced beets.

Julienne, French Style or Shoestring means canned beets consisting of strips of beets.

Cut means canned beets consisting of units irrespective of whether such units are"segmented" or "wedge-shaped," (1) which are not uniform in size or shape or (2) which do not conform to any of the foregoing styles.

Suggested Label Weights (Net Weight)

Beets (Sp. Gr. 1.04)		Lbs.	Ozs.
8Z Tall	211 x 304	.	8¼
No. 1 Picnic	211 x 400	.	10½
No. 1 Tall	301 x 411	1	.
No. 303	303 x 406	1	.
No. 2	307 x 409	1	4
No. 2½	401 x 411	1	12
No. 10	603 x 700	6	8

Minimum Drained Weights (Ounces)

Container designation	Whole	Diced	Cut	Sliced	Julienne
No. 2	12½	13	13	12½	11
No. 2½	19½	19½	19	19	18
No. 10	71	72	72	71	68
16 oz. glass	10½	10½	10	9½	9
No. 1 picnic	7¼	7½	7½	7¼	7

Sizes of Beets in Whole Beets

The size of any beet is determined by measuring the shortest diameter through the center transverse to the longitudinal axis of the beet.

Designation Word & No.	Count Range per Container				
	No. 1 Picnic	No. 2 Can	No. 2½ Can	No. 10 Can	16 oz. Glass
Tiny					
Size 1	25 and over	50 and over	70 and over	250 and over	35 and over.
Size 2	18 to but not including 25.	35 to but not including 50.	50 to but not including 70.	175 to but not including 250.	25 to but not including 35.
Small					
Size 3	12 to but not including 18.	25 to but not including 35.	35 to but not including 50.	125 to but not including 175.	18 to but not including 25.
Size 4	8 to but not including 12.	15 to but not including 25.	20 to but not including 35.	75 to but not including 125.	10 to but not including 18.
Medium					
Size 5	5 to but not incuding 8.	10 to but not including 15.	15 to but not including 20.	50 to but not including 75.	7 to but not including 10.
Size 6	Less than 5	Less than 10	Less than 15	Less than 50	Less than 7.
Assorted sizes.1	Mixed sizes.2				

Sizes of Slices in Sliced Beets

The size of any slice in sliced beets is determined by measuring the shortest diameter of the surfaces of the slice.

Word designation	Shortest diameter in inches
Small	Less than 2 inches.
Medium	From 2 inches up to but not including 2½ inches.
Large	Not less than 2½ inches.

Assorted sizes is a combination of any two adjacent sizes.

Mixed sizes is a combination of all designated sizes.

CARROTS (Daucus Carota)

There are usually three sizes used in canning: small whole, which are about 1 to 1¼ inches in diameter; split that are about 1¼ to 1¾ inches in diameter, cut into discs and packed for soups, and diced.

When received at the packing plant, carrots should be thoroughly washed to remove any clinging extraneous matter before being cleaned for packing.

They have been successfully lye peeled the same as sweet potatoes or peaches and scraped or cleaned in a potato peeler. Due to their long conical shape, they are not peeled so economically by this last method. Blanch for 10 minutes at 212° F., fill containers and cover with a hot 2% salt brine.

Exhaust No. 1 and No. 2 can 3 minutes and process 25 minutes at 240° F. Exhaust a No. 3 can 3 minutes and process 25 minutes at 240° F. Process No. 10 tins for 45 minutes at 240° F.

Styles of Canned Carrots

Whole carrots are carrots which retain their original conformation after trimming and peeling.

Sliced carrots are carrots which are cut into slices not thicker than ¼-inch.

Quartered carrots are carrots which have been longitudinally cut into four approximately equal units. Carrots which have been cut in half, the units of which approximate in size the quartered units in the can are also permitted in this style.

Diced carrots are carrots which have been cut into cubes not larger than ½-inch square.

Shoestring carrots are carrots which have been cut into strips of varying lengths, not to exceed 3/16-inch in cross section.

Cut carrots are carrots which are cut into unsymmetrical pieces not conforming to any of the above named styles.

Recommended Processing Temperatures and Times

Carrots, whole, sliced, diced or shoestring, packed in brine

Can name	Dimensions	Retort temperature Deg. F.	Time Min.
No. 1 (Picnic)	211x400	240	30
		250	20
No. 2	307x409	240	30
		250	20
No. 2½	401x411	240	30
		250	20
No. 10, except sliced	603x700	240	40
		250	27
No. 10, sliced	603x700	240	45

Carrots, whole, cut, quartered, sliced, diced or shoestring

Jar size	Dimensions	Retort temperature Deg. F.	Time Min.
No. 303	303x411	240	30
No. 2½	401x414	240	30

Suggested Label Weights (Net Weight)

Carrots (Sp. Gr. 1.04)		Lbs.	Ozs.
8Z Tall	211 x 304	.	8¼
No. 1 Picnic	211 x 400	.	10½
No. 1 Tall	301 x 411	1	.
No. 303	303 x 406	1	.
No. 2	307 x 409	1	4
No. 2½	401 x 411	1	12
No. 10	603 x 700	6	9

Minimum Drained Weight (in ounces)

Style	8Z Tall	No. 2	No. 2½	No. 10
Quartered and Diced	6¼	14½	18½	72
Other Styles	6	14¼	18	67

The maximum size requirements and maximum variations (in inches) for the various styles of carrots are shown below:

Uniformity of Size (Inches)

	Whole		Sliced			Quartered	Diced**	Shoestring***	Cut
	Max. Diam.	Diam. Var.	Length Var.	Thickness	Max. Diam.	Diam.* Var.	Diam. of Whole Carrot	Max. Cross Cube Sections	
Grade A	1¼	3/16	⅝	¼	1¾	⅜	1¾	⅜	⅛ sq. Not scored
Grade C	1¾	⅜	1¼	⅜	2¼	¾	.....	½	3/16 sq. Irregular

* Excluding occasional small slices not representative of general size.
** Shall contain not more than (Grade A) 10%, (Grade C) 25% pieces by weight smaller than½ cube or large and irregular in shape.
*** Shall contain not more than (Grade A) 10%, (Grade C) 25% by weight less than ½ inch in length.

Glass containers arrive at the processing plant in cartons which are re-used for shipping of the finished product.

CAULIFLOWER (Brassica Oleraceae var. Botrytis)

Use only well flowered heads, cutting away the heavy stock. Blanch in boiling water 3 minutes, then plunge into cold salt brine made by dissolving 12 pounds of salt in 40 gallons of water. If possible, the cauliflower should remain in the salt brine over night in order to produce a much finer color and flavor. This may also produce a white product. Use 6 pounds of salt per 40 gallons of water.

If this method cannot be used then blanch in water containing 1 ounce of citric acid per gallon. This gives the product a white appearance.

Allow the cauliflower to remain in the salt brine 15 to 20 minutes to cool, but use a stronger brine. Rinse and fill into cans and cover with a 2% hot salt brine, exhaust, cap, and process.

Recommended Processing Temperatures and Times

Cauliflower

Can name	Dimensions	Retort temperature Deg. F.	Time Min.
No. 1 (Picnic)	211x400	240	20
No. 2	307x409	240	20
No. 2½	401x411	240	20

Suggested Label Weights (Net Weight)

Cauliflower (Sp. Gr. 1.00)			
No. 1 Picnic	211 x 400	.	10
No. 1 Tall	301 x 411	.	15½
No. 303	303 x 406	.	15½
No. 2	307 x 409	1	3
No. 2½	401 x 411	1	11
No. 10	603 x 700	6	4

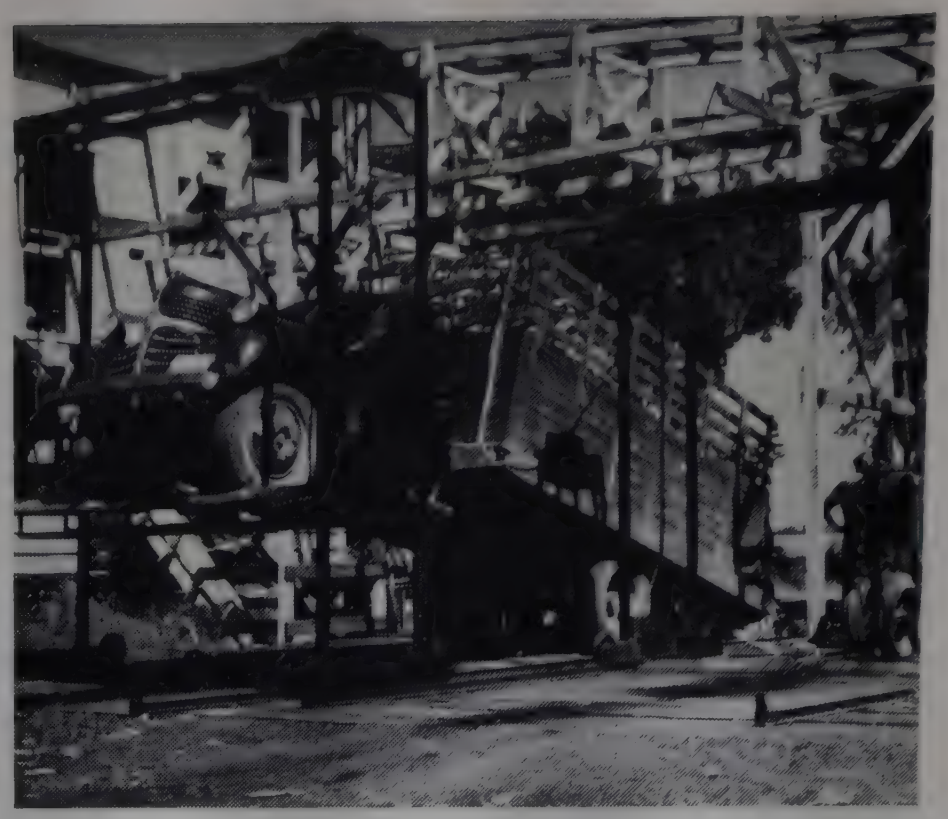
CORN (Zea Mays)

Modified from that written by Milo R. Daughters

It is well not to attempt the packing of corn unless it can be done on a scale large enough to justify installing the best up-to-date machinery. The equipment should be ample to take care of the peak load, otherwise the processor must be willing to pass one or more fields during an unsatisfactory season. For flavor and tenderness the best results are obtained by packing the corn the same day it is picked. Unless a packer is able to meet these conditions it is better not to make the attempt.

HUSKING:—Nearly all commercial canners use mechanical huskers. The best machines, when properly fed, will do excellent work. The husked corn is carried by conveyor to a brush silker or directly into a washing machine. The brushing removes the excessive and adhering silk and the washer removes wormy and black spots so that the inspector can see and distinguish the exact portion, which must be cut off. Small motor driven trimmers or butcher knives are used to remove the worm eaten or other undesirable parts of the ear. From the inspection belt the corn is carried into a second washer and thence to the cutting room, where it is distributed to bins conveniently placed for the individual machines.

MAINE STYLE PACK:—Cutter knives are adjusted so as to cut the grains about one-half of the way from the top and the scrapers are relied upon to remove the remainder and not to cut the cob. The scrapers are adjusted to bear as heavily upon the cob as possible without tearing it. It is impossible to make a good looking can of corn with dull knives or improperly adjusted scrapers. Change the knives every five hours and oftener if the appearance of the cob indicates that the knives in that particular cutter are not making a clean cut. The machines are designed to take the nose of the ear first. When fed silk end first the springs, knives, and scrapers open relatively slowly owing to the natural taper of the ear as it passes through and the best



This device for unloading trucks by lifting up the front wheels is commonly seen at sweet corn canning plants in the Midwest.

results are obtained. Feeding ears butt first results in poor workmanship, waste of corn, and frequent blocking.

A standard knife grinder and a carborundum stone for honing purposes are essential for the cutter room.

The cut corn is passed directly into a silking machine where nearly all the silk and most of the cob are removed. The final silking operation occurs when the corn has been heated with brine and is allowed to pass from the cooker-filler mixing chamber to the filling reservoir. A special silking device is placed between these two compartments. It removes large quantities of silk as well as hulls, and bits of cob.

BRINE:—No definite standards have been used by canners regarding the amount of sugar and salt used in a given quantity of brine. Each packer uses the amount which he thinks will best meet the demand of his buyer. For Standard quality the amounts used vary from none to 40 pounds of sugar and 12 to 28 pounds of salt to 100 gallons. For Extra Standard corn the sugar used will vary from 50 to 80 pounds and the salt 15 to 22 pounds to 100 gallons. For Fancy quality the amount of sugar will vary from 50 to 150 pounds and the salt from 15 to 25 pounds per hundred gallons of brine. The use of 28 pounds of salt in Standard corn with 40 pounds of sugar is an extreme case and the corn is entirely too salty for the human taste.

The brine is brought to boiling and added to the corn at the rate of about 20 gallons of brine to 80 gallons of corn during the first few days of the pack, but usually has to be increased as the season progresses and the quantity of starch increases. Uniform consistency is greatly to be desired and almost impossible of accomplishment when mixed with the brine in this way; owing to variations in the maturity of the corn, the judgment of the operator from day to day, and the amount of steam condensed. As much as 30 gallons of brine may have to be added to older, more mature corn.

A number of packers measure the sugar, salt, and water separately and in that way each batch has the same degree of sweetness. Still others use a mixing machine whereby a predetermined amount of brine is added by means of a pump, which operates at a uniform rate. This machine is so adjusted and operated that it will deliver a steady flow of mixed corn and brine to the cooker-filler. A capacity of 120 containers a minute is all that is necessary for any corn line.

A machine is extensively used for the purpose of blending the corn and brine and producing an even flow of starch. The temperature to which the corn is heated in this mixer need not exceed 160° F. especially for young corn, which if heated

too much and too long will have a more pronounced curdled appearance. By means of a pump the corn may be transferred to the cooker-filler, if it is on the same floor, or if the mixing is done overhead, it may be allowed to flow by gravity into the upper reservoir of the filling machine.

FILLING CONTAINERS:—The cooker-filler stirs and preheats the corn and brine to the proper temperature for filling. This temperature is placed at about 190° F. by most packers. It would be well if all the gases held within the grains of corn could be expelled by heating until the corn ceased to foam. Foaming corn may result in a slack fill. From the preheating reservoir the corn drops slowly and with regularity into the filling chamber from which it is forced out in measured quantities into the cans which are fed by gravity into the machine. The containers are sealed at once.

Recommended Processing Temperatures and Times
Corn, cream style

Can name	Dimensions	Initial temp. Deg. F.	Retort temp. Deg. F.	Time Min.
No. 1 (Picnic)	211x400	180	240	85
			245	65
			250	55
No. 303	303x406	180	240	90
			245	75
			250	65
No. 2	307x409	180	240	90
			245	80
			250	70
No. 10	603x700	180	240	180
			245	160
			250	145

Jar size	Dimensions	Initial temperature Deg. F.	Process time at 240° F. Min.	Process time at 250° F. Min.
303	303x411	160	105	80
303	303x411	180	100	75

COOLING CORN:—It requires 30 to 40 minutes to cool No. 2 cans of corn. The variation in time depends upon the conditions of cooling such as temperature of water and whether or not the cans are rolling. All No. 10 cans of corn must be cooled for 25 minutes under the same or slightly increased pressure at which they were cooked in order to prevent buckling.

View of corn husking with all workers wearing aprons, gloves and hair netting for protection of product and themselves.

Suggested Label Weights (Net Weight)

Corn, Cream Style (Sp. Gr. 1.08)		Lbs.	Ozs.
8Z Tall	211 x 304	.	8¾
No. 1 Picnic	211 x 400	.	11
No. 1 Tall	301 x 411	1	.
No. 303	303 x 406	1	.
No. 2	307 x 409	1	4
No. 3 Cylinder	404 x 700	3	2
No. 10	603 x 700	6	10

FLAT SOURS:—Cooling of corn is very important because of the presence of thermophyllic (heat loving) bacteria, which may not have been killed during the cooking period. They are rendered inactive in corn which is cooled to a temperature below 100° F. but if not reduced in temperature they multiply rapidly and as a result of their activity they transform the sugar of the corn into lactic acid and in this manner produce sour corn. Owing to the fact that no gas is produced to make the cans bulge at the ends such goods is referred to as "flat sours."

Some processors have the impression that flat sours are produced by allowing corn to stand on the platform in heaps for two or three days. This impression is erroneous. While the corn loses all its natural flavor and aroma by such delay and while its natural acidity appears to be increased somewhat, the corn never acquires the same degree of acidity as that produced by bacterial action.

Canning of Whole Kernel Corn

Whole kernel corn is relished and often preferred by those who have eaten it to any other "style" pack, because it brings to the consumer as near the natural fresh corn taste and shape as possible without the soft mushy appearance and sweet taste.

CHARACTER OF CORN:—In packing of whole kernel corn, it is necessary that the corn be sufficiently mature to retain its shape during handling and processing. Under-mature corn is objectionable on account of the fact that it is difficult to cut and is liable to leave too many hulls in the can. Over-mature corn does not produce an acceptable product. The best product is obtained by taking the corn as it comes from the fields and sorting on picking belts. The best corn is used for whole kernel or whole grain corn, while the other is used for cream style corn.

HUSKING:—Formerly, corn for whole grain packing was husked by hand, it being maintained that it was impossible to secure a fancy corn by machine husking. However, at present, the majority of packers of fancy whole grain corn are using machine husking and such huskers are necessary in volume production.

WASHING:—The ears should be passed through a squirrel cage washer under a fine water spray of high pressure. Many canners also use a corn brushing machine either before or after the spray washer. After washing, the ears should pass over a belt for the usual inspection, trimming, and sorting.

CUTTING:—Whole grain corn is cut both by hand and machine. Machine cutting is used to a large extent in most of the more important whole grain canning factories. In machine cutting of whole grain corn there is some crushing of the kernels, causing milkiness of the liquid. On this account, it was formerly the custom to first set the starch in the corn by giving it a blanch in hot water of 4½ to 5 minutes at a temperature of 170-180° F. Before going to the cutters, the blanched corn was chilled in cold water to a temperature around 70° F. However, the custom of blanching corn previous

Close-up of the husking operation with corn, conveyed from the unloading chutes, entering at the top of the photo.

to cutting has been almost entirely discontinued and satisfactory results are being obtained with the whole grain cutters now in use.

Hand cutting is used to a considerable extent in some factories, particularly in the Maryland section. This operation is generally carried out as follows:

The husked ears are placed in clean galvanized tubs or baskets. These containers for the corn are then transferred to a table and the corn cut from the cob by hand with a sharp knife, the blade of which is approximately 6 inches long. The best manner of accomplishing this is to proceed as follows: secure smooth, hard wood board 10 inches by 12 inches, one for each woman operator; drill a ¼-inch hole through both corners at one end of the board; and through these holes thread strong twine so that the operator can hang this board around her neck so that it will hang in front of her bosom. The best material for the boards is maple, but any white hard wood will answer. The operator puts this board in front of her and sits at a table with the board over a bucket so that, by holding the ear of corn at the top of her left hand and the butt of the ear against the board, she can cut the kernels from the ear and they will fall directly into the bucket.

INSPECTION OF CUT CORN:—Cut kernels are transferred to a picking belt in a thin stream so that the inspectors seated at the belt may remove any defective kernels or any bits of cob which have resulted from cutting too deeply into the ear.

WASHING OF CUT CORN:—Washing cut kernels is an operation which is important in obtaining a pack free from spoilage. In several instances of putrefactive spoilage the cause has been directly traced to a high contamination of the cut corn with bacteria from equipment through which or over which the corn has passed. Strict cleanliness of such equipment reduces the contamination. The "glass type" shaker washer as used for peas may be satisfactory in some instances, but this washer is not as efficient as some other types of washers made especially for the purpose. If some flotation type of washer is used, this should be followed with a spray wash of some kind using fresh water.

Such washers also remove a considerable proportion of the "fines" and give a product with a clearer liquid and also one which heats more rapidly to the center of the can than when "fines" are present.

The corn should be passed over a draining belt before going to the filler.

FILLING AND BRINING:—Inspected kernels are transferred to a filler, dropped into containers, and brined with boiling hot water or a weak salt brine. When salt is used, the amount per 100 gallons of water varies from 5 to 12 pounds. Some packers do not add sugar to whole grain corn; some packers use as much as 30 pounds of sugar per 100 gallons of brine. The brine should be added at or near the boiling temperature.

The fill of containers should be adjusted so that they do not have an excess of corn. Overfilling cans makes the corn more difficult to sterilize and may result in spoilage.

EXHAUSTING AND PROCESSING:—After being filled and brined, they should be passed through a steam exhaust box so as to give an exhaust sufficient to raise the average temperature of the contents to 175-180° F. at the time of sealing. This requires from 4 to 6 minutes for No. 1 or 2 cans, depending on the efficiency of the exhaust.

Suggested Label Weights (Net Weight)

		Lbs.	Ozs.
Corn, Whole Grain (Sp. Gr. 1.08)			
8Z Tall	211 x 304	.	8¾
No. 1 Picnic	211 x 400	.	11
No. 1 Tall	301 x 411	1	.
No. 303	303 x 406	1	.
No. 2	307 x 409	1	4
No. 3 Cylinder	404 x 700	3	2
No. 10	603 x 700	6	10
Corn, Vacuum Pack			
No. 2 Vacuum	307 x 306	.	12

Recommended Processing Temperatures and Times

Corn, whole kernel in brine

Can name	Dimensions	Retort temperature Deg. F.	Time Min.
8Z Tall	211x304	240	50
		245	35
		250	25
No. 1 (Picnic)	211x400	240	50
		245	35
		250	25
No. 303	303x406	240	50
		245	35
		250	25
No. 2	307x409	240	50
		245	35
		250	25
No. 10	603x700	240	80
Corn, whole kernel, vacuum pack			
No. 2 vacuum	307x306	240	55
		245	45
		250	35

(a) These processes apply only if the sweet corn is well cleaned.

(b) The processes given above are dependent on the following factors for maintenance of their intended sterilizing value: (a) The maintenance of 23 inches of can vacuum immediately before processing; (b) the presence of at least

one ounce of free liquid; (c) the control of fill-in weight not to exceed 11¼ ounces of washed corn.

Corn, whole kernel, in brine

Jar size	Dimensions	Retort temperature Deg. F.	Time Min.
303	303x411	240	50
		245	40
		250	30

Canned Corn on the Cob

Modified from that written by Dr. E. W. Eickelberg, Fairmont Canning Company

The earlier brine packs of corn on the cob had the objectionable features of being soggy and developing a cobby flavor upon storage. This method of packing has been practically superseded by the more recent vacuum pack to preserve freshness and flavor.

Specially developed eight-row bantam strains of sweet corn which possess a slender ear of sufficient length to permit trimming, a tiny cob, and tender, succulent kernels spaced uniformly without gaps between paired rows, are best adapted to this type of pack.

The corn is harvested at a slightly earlier stage of maturity than corn to be used for whole grain packs. The raw product uniformity should be controlled by moisture, puncture or thumb tests by experienced individuals. Further sorting on the inspection belts is necessary to maintain uniform quality and maturity.

An efficient machine for trimming ears to a desired even length consists of a belt with attached U-shaped aluminum ear carriers for holding the ear as it passes between rapidly rotating sharpened discs.

The size (diameter) grading is essential for ease and rapidity of packing in the different diameter cans available. The diameters of the ears may vary from 1¼ to 1⅞ inches. Improper sizing causes bruising and tight pack in cans. Packing operations are retarded, and the ears are difficult to remove. Among the variety of size graders that have been tried, the shaker, cylindical, rope or cable and rubber V-belt types have met with various degrees of success.

Particular caution should be exercised in the handling and packaging of the husked ears so as to prevent bruising of the kernels. Otherwise, an undesirable scum may appear just above the liquid level. This objectionable material consists largely of protein and starch from the open kernel. Blanching 4½ to 5 minutes at 170-180° F. or washing thoroughly in clear cold water preliminary to packing has proven effective in producing a saitsfactory canned product.

To each hand-filled can is added sufficient water to form vapor when closed under 28 inches of vacuum. Various amounts of water up to ¾ ounce per ear have been successfully used. Salt and sugar may be added but too much sugar may cause a darkening or carmelization and shrinkage of the kernels.

Processes necessary for vacuum packed corn on the cob are dependent to a marked degree upon the factors of maturity, variety, fill, amount of water added, and conditions tending to reduce the vacuum. It should not be packed without directions from a research laboratory connected with the canning industry.

New Type Packs*

A new type of cream style corn known as "Cremogenized" corn was introduced into commercial production in 1947. This type of corn is prepared by cutting the kernels from the cob in the manner followed by packers of whole kernel corn, then silking, screening, washing, and inspecting. A portion of the whole kernels are then mechanically cut by a comminuter to a creamy, semi-liquid consistency. This creamy material is then mixed with the remainder of the whole kernels and the proper proportions of salt, sugar, and water. The corn is then placed in the can and processed the same length of time as for standard cream style corn. This procedure is patented.

* Information supplied by Dr. C. Olin Ball, Rutgers University.

Filling No. 303 cans with kernel corn and a weak salt brine or brined with boiling water. Some packers add sugar.

Another new type of cream style corn is known as "Cremogevac" corn. The process for making this style corn is a modification of the "Cremogenized" corn process. In the "Cremogevac" process the finely cut kernels, of creamy consistency, are placed in the can separately from the whole kernels and the sugar-salt brine. The can is then vacuum sealed (doesn't have to be vacuum sealed if filled hot), processed, cooled, and then mechanically shaken so that the component parts are well mixed. The processing time for "Cremogevac" corn is shorter than that for "Cremogenized" corn or standard cream style corn because the thick, creamy component which heats slowly occupies only 25-35% of the volume of the can. The whole kernels and the brine heat rapidly as they are of thin consistency. This process also is patented.

Hominy

Two grades of corn may be used for packing this product. In the South and West, only white corn is used whereas in certain sections of the North only the yellow hominy can be obtained. To make white hominy, the white dent corn of the broad type kernel, hard and flinty should be used. Do not use mixed corn. There are a number of methods for making lye hominy of which the following is one. Have a round tank about 4 feet deep, and equip it with a stout stirrer. A larger tank is used to remove the lye while the corn is cooking. Add 400 pounds of clean corn to the tank, and add water to cover six inches above the top of the corn; turn on the steam and have the water boiling before attempting to start the agitator, as the corn packs closely on the bottom, making it almost impossible to start unless the corn is stirred or agitated first. After the agitator is started add enough lye to make a 2% solution (the more lye the shorter the time re-

quired to remove the hulls with less absorption of lye).

PRECAUTION:—Care must be taken when adding lye to hot water to prevent splashing and foaming. Make a liquid of the lye by adding it to cold water and then add this solution to the corn, a small quantity at a time. Lye has a caustic effect on the skin, so care must be taken to prevent splashing.

The corn is often added to a boiling 2% lye solution and kept boiling slowly for about 40 minutes. Where fresh corn is used, the temperature can be reduced. Some prefer using a 1% lye and giving a longer cook, as they believe the lye is not absorbed as readily and is more easily removed. The weaker the lye, however, the longer the time required in handling. Less than a 2% solution requires too long cooking while over 2% is apt to cause discoloration due to lye burning.

After removing the lye, boil in fresh water several times, the hominy can be bleached to make a whiter product by using one and one-half ounces sodium bisulphite for each bushel of corn and boiling for about 15 to 20 minutes. The sulfites should be removed as much as possible by washing several times in fresh water (at least three changes). Certain states have ruled against sulphites in food products, and it is advisable to have the hominy analyzed if shipments are to be made into these states.

As soon as the hull is loosened, the corn must be passed to the hulling machine as rapidly as possible as delay in removing the surplus lye might cause the corn to soften. A tomato pulping machine with an 8-mesh wire sieve may be used for this purpose by attaching an inch perforated pipe by means of a hose to the top of the cover of the machine. Start the water in the pulping machine, and draw off the corn from the lye tank, passing it through the pulper, and then to the cooking tank. Fill the tank with fresh water to within a few inches of the top. Start the agitator, turn on the steam and cook until the corn is soft enough to mash between the teeth. This will require about an hour to an hour and a half.

Fill for Hominy

Size of Can	Soaked Overnight	Not Soaked Overnight
2	10½ ounces	11 ounces
2½	13½ ounces	14 ounces
3	16¼ ounces	17 ounces
10	50 ounces	56 ounces

Packaged cans being fed into production lines 400 per minute with unloader-unscrambler. Sliding dolly positions packages of cans, jack elevates each layer to level of unscrambling table.

Cover with either hot brine or hot water. Lye hominy should be packed in "C" enamel cans to prevent discoloration. This is especially true if the corn is comparatively dry packed. Cool rapidly to prevent discoloration.

Recommended Processing Temperatures and Times
Hominy, lye and pearl

Can name	Dimensions	Initial temperature Deg. F.	Retort temperature Deg. F.	Time Min.
No. 2	307x409	...	240	75
No. 2½	401x411	...	240	90
No. 10	603x700	...	240	120

Hominy, lye and pearl

Jar size	Dimensions	Retort temp. Deg. F.	Time Min.
303	303x411	240	75
2½	401x414	240	90

Suggested Label Weights (Net Weight)

Hominy (Sp. Gr. 1.05)		Lbs.	Ozs.
No. 303	303 x 406	1	.
No. 2	307 x 409	1	4
No. 2½	401 x 411	1	13
No. 10	603 x 700	6	9

OKRA (Hibiscus Esculentum)

Use only the fresh tender okra. If small, it may be canned whole; otherwise cut it into pieces about one inch long. Blanch in boiling water for several minutes before cutting. Chill in a salt brine made by dissolving 6 pounds of salt in 40 gallons of water for 10 minutes. Fill into containers, cover with dilute brine.

Recommended Processing Temperatures and Times
Okra

	Initial temperature Deg. F.	Retort temperature Deg. F.	Time Min.
No. 1 (Picnic) 211x400	...	240	17
No. 2 307x409	...	240	17

Type of Canned Okra

Cut Okra consists of portions of whole okra pods cut into lengths varying from ½ to 1 inch. The description of grades outlined herein will suffice for "cut" okra, the term "practically whole" meaning, when applied to "cut" okra, that the portions of the pod are intact, not shattered or broken, except as ordinarily occur in the careful preparation and handling of the product during the process of canning. "Reasonably whole" means that the portions of the pods are intact and not shattered or broken to an extent which will detract appreciably from the appearance or impair its use commercially.

Suggested Label Weights (Net Weight)

Okra (Sp. Gr. .99)		Lbs.	Ozs.
No. 1 Picnic	211 x 400	.	10
No. 1 Tall	301 x 411	.	15½
No. 303	303 x 406	.	15½
No. 2	307 x 409	1	3
No. 2½	401 x 411	1	11
No. 10	603 x 700	6	3

ONIONS

There is little demand for this canned product. However, several methods of preparing onions for canning are available. One is to peel them with a hot gas flame for 3 seconds as they roll down an incline. This burns off the skins after which they are washed thoroughly and the root and stem ends trimmed off. Another method is to blanch the onions in boiling water from 1½ to 3 minutes to loosen the skins

skin so it can be easily removed. Another method is to peel the onions automatically in a machine or vegetable peeler. Last mentioned methods show greater losses than the first one.

The onions should be washed thoroughly and the root and stem ends cut off to lessen discoloration. Blanch several minutes after trimming but care must be taken not to blanch at too high a temperature or for too long a period as this might loosen the onions and cause them to break apart.

Onions should be packed in "C" enameled cans to prevent black discoloration. Onions contain considerable loosely combined sulfur which is liberated during canning and unless "C" cans are used the liberated sulfur will combine with the metals of the cans.

Cover with a 2% salt brine, exhaust and close.

Recommended Processing Temperatures and Times

Onions

Can name	Dimensions	Retort temp. Deg. F.	Time Min.
No. 1 (Picnic)	211x400	240	20
No. 2	307x409	240	20
No. 2½	401x411	240	20
No. 10	603x700	240	35

Suggested Label Weights (Net Weight)

Onions (Sp. Gr. 1.01)		Lbs.	Ozs.
No. 1 Picnic	211 x 400	.	10
No. 1 Tall	301 x 411	.	15½
No. 303	303 x 406	.	15½
No. 2	307 x 409	1	3
No. 10	603 x 700	6	5

PEAS (Pisum Sativum)

Modified from that written by Milo R. Daughters

DELIVERY:—It is better for the processor to own a pea harvester, otherwise there is likely to be delay in cutting the peas when they are at the right stage of maturity.

Contracts usually specify that peas shall be delivered when the pods are well filled, green and tender, and when at the best condition for table use. This is the stage when the oldest pods are well filled. If the peas are threshed at viner stations removed from the factory they should be placed in perforated galvanized iron containers, each having a capacity of about 40 pounds and delivered promptly by truck. If wooden boxes are used, some provision should be made to steam them after each delivery. A combination spray washer and steamer should be used.

There are two methods used to pay the farmer. In the one case the farmer is paid according to grade. A small sample grader is installed on the receiving platform and a weighed quantity of peas are put through. The various sizes are weighed separately and the farmer paid accordingly.

THRESHING:—Viner stations should not be more than 15 miles from the factory and less than that if there is no paved highway, over which the trucks may be operated. There should be one viner for 35 acres, if the peak load is to be handled efficiently. Each viner should be equipped with a variable speed pulley. Careful supervision of the viners is essential if the bruised peas and splits are to be reduced to a minimum, since it is in this machine that the trouble in this respect is started. The tiniest crack, one which is invisible to the naked eye, will become a split in the grader or blancher.

STORAGE:—It is a good plan to start peas through the production line just as soon as possible after threshing. It may be helpful to be equipped with storage tanks so the peas pass through cold water right after the cleaning machine and the washer. The cleaner is employed to remove pods, pieces of stem, thistle blows, leaves, etc. From the cleaner the peas are dropped into the washer for the removal

It is best for the canner to own the pea harvesting equipment (above) to avoid delays in harvesting crop at right maturity.

of splits and skins, mud balls, thistle buds, and pebbles.

GRADING PEAS:—Graders consist of cylindrical sieves with perforations. The No. 1 sieve contains perforations 9/32 or 18/64 inches in diameter and are often referred to as sieve 9 or sieve 18. The No. 2 sieve perforations are 10/32, the No. 3, 11/32, the No. 4, 12/32 and the No. 5, 13/32 inches in diameter. No. 6 peas go over the end.

There are three general types of grading units. One grader has sieves five feet in diameter by five feet long. Perfect grading is obtained from this machine when it is composed of two units. The first or primary grader contains three sieves each of No. 3 and 4. It has a slope of one to one and one-half inches per sieve. The regrading unit contains three each of No. 1 and 2 sieves. It is operated at the rate of 7 r.p.m. The No. 1's, 2's, and 3's are carried over to the regrader. For sweets the first unit should have two each of No. 3, 4, and 5 sieves. Good results may be obtained if the grader is not overlooked by employing a single grader containing two sieves each of No. 1, 2, 3, and 4.

The nested graders are space economizers, but they are difficult to clean and do not give efficient grading, when capacity is desired.

The recent tendency in the newer type of graders has been to make them of small sieves, which have a diameter of 20 inches. These graders are arranged to divide the stream of peas into three parts and to keep the peas in constant motion. So long as the peas lie in a quiescent condition no grading takes place. Besides being of three-fold capacity these graders contain a regrading section as part of the unit.

Regardless of the type of grader installed, they all have their maximum capacity for efficient grading and when this is exceeded by overloading, they will do poor work. Overloading results in a "carry-over" of smaller into the larger sizes with consequent loss to the factory owner. It is better to feed the peas into the grader evenly and in a steady stream than to overload for a half-hour, and then have the grader idle. Feeding by conveyors is more satisfactory than feeding by hand.

There are two methods of proceeding after the peas are graded. One is to pass the different grades over picking tables where they are inspected for the purpose of removing splits, pebbles, thistle buds, etc. Some packers use washers which do not remove pebbles or thistle balls and so it is necessary to take these out somewhere along the line. Some

Peas being discharged from a bin truck into conveyor which carries them to cleaner in background. Next they go to washers.

packers employ eight or ten women to each table to inspect the peas at this point while other packers have no more than two and in some instances none. From these picking tables the peas are carried directly into the blancher.

A few packers are passing the peas from the grader directly into the blancher and from the blancher through a shaker or rotary washer and then upon the picking table. In this way it is claimed that all splits may be removed, and any discolored peas, especially those that turn white because they show up after blanching.

BLANCHING PEAS:—Purpose of blanching is twofold. It removes the soluble constituents from the surface and covering membrane of the pea and coagulates the protein so as to effectively seal up the remaining soluble materials such as starch, which, if allowed to escape, would produce a cloudy liquor. The second object to be accomplished by blanching is to saturate the peas as much as possible with water. The starch combines with water and so does not swell up as much in the can during processing. Blanching, therefore, helps to overcome the danger from overfill with over-ripe or hard mixed peas. Peas of this quality should never be placed in containers.

Too much blanching breaks down the protecting cell walls of the meaty portion of the peas so that processing may allow starch to get out into the surrounding liquor. Peas that come out of the blancher in a wrinkled condition are over-blanched. They are mushy in the over-head bins above the filling machines and stick so that it is necessary to hammer the bin with a wooden mallet or other means to jar the peas loose. If over-blanched, the finished product will be turbid except for the small amount of sugar and salt remaining in the brine. The liquor is without any color and may be clear or cloudy, depending upon the variety and size of the peas. Blanching for Alaska 1's and 2's

and for 1's, 2's, and 3's sweets is sufficient. Alaska 3's will stand four to five minutes; also 4's and 5's sweets, if in prime condition. Give Alaska 4's and 5's from five to eight minutes. The temperature of blanching is fom 208 to 210° F. Sweets require very little blanching as compared to Alaskas. If peas are not blanched they possess a cloudy liquor, but a delicious flavor.

As the peas issue from the blancher they pass into a washer. Two types are used, the shaker washer and the rotary. Very little washing is required—just enough to remove the blanch water and to carry away splits or skins. Some packers use a spray of warm water while others use cold. Those who use hot water claim that cold water causes the peas to crack thereby increasing the number of splits. Peas that are not injured or that do not contain microscopic cracks will not crack even in extremely cold water. In the rotary washers the peas are often crushed under their own weight if the washer is heavily loaded.

Canners have often tried to separate hard peas from young, tender peas by means of salt solutions, but the attempts have always been made with the peas before they were blanched and have proved unsuccessful, notwithstanding claims made by some canners to the contrary. It has recently been discovered that blanching brings about changes which make it possible to separate hard from young, tender peas by the use of a salt solution of about 45° salometer test. A machine has been manufactured to accomplish this result. As the peas come from the salt solution they are sprayed at once with cold water to remove the salt, which would cause them to shrivel if not removed promptly.

BRINE:—Some packers use more sugar on the Alaska variety than they do on the sweets while others make no distinction. The following formulae will give an idea of the amounts used:

Gallons of Water	Pounds of Sugar	Pounds of Salt
100	30	20
100	20	15
100	15	15

The brine should be kept near the boiling point while it is being used and storage tanks should be as near the filler as possible.

FILLING:—When peas are suitable for canning, 13 ounces give about the proper fill for the larger sizes and 13½ to 14 ounces for the smaller sizes. Smaller sieve sizes fill in more closely and consequently a given volume will weigh more than for the larger sizes. After processing and cooling cutting samples will reveal whether or not the fill is right. If the peas come to within a quarter of an inch of the top and are covered with an eighth inch of liquor or brine, the fill is correct. The drained weight of peas must not be less than 12½ ounces and in perfectly packed peas, it will range from 13 to 14 ounces.

GENERAL REMARKS:—No one should pack peas unless they have an abundant supply of good water. Some canners use an average of a gallon of water in the preparation of every No. 2 can of peas. Soft water makes a more tender product than hard water. The installation of a water softener may be necessary in some localities.

Peas should be put through the viner the day they are cut. If it is necessary to carry them over on account of a breakdown or other reasons, store them in tanks of cold running water.

Peas should not be transported in wooden boxes unless the boxes are washed with hot water thoroughly each time.

The best grade of salt should be used in the brine. The impurities should not exceed one-half of one per cent.

A gallon of brine should cover the peas for fifteen No. 2 cans. Some canners do not get more than 10 per gallon of brine. This represents a loss of four-fifths of a gallon per

case and so amounts to 40,000 gallons on a 50,000 case pack.

Cloudy liquor on peas is caused by omitting blanching, by bacterial development in the can after it is packed or by over-cooking the larger sizes, especially size four Alaskas, at temperatures above 240° F. Over-blanching may result in a spoonful or more of soupy peas in the bottom of the can.

Recommended Processing Temperatures and Times

Peas

Can name	Dimensions	Retort temp. Deg. F.	Time Min.
8Z Tall	211x304	240	35
		245	25
		250	15
No. 1 (Picnic)	211x400	240	35
		245	25
		250	15
No. 303	303x406	240	35
		245	25
		250	15
No. 2	307x409	240	35
		245	25
		250	15
No. 10	603x700	240	50
		245	35
		250	23

Peas

Jar size		Retort temp. Deg. F.	Time Min.
303	303x411	240	45

Types of Canned Peas

Canned peas are of two types:

Early peas are peas of early maturing or other smooth skin varieties.

Sweet peas (or Sugar peas) are peas of later maturing, wrinkled varieties which have a natural sweet flavor.

Definition of Sizes

Certificates of grade covering canned peas shall indicate the size or combination of sizes found upon examination. The various sizes of canned peas are as follows:

No. 1 size peas are peas that will pass through a screen of 9/32-inch mesh.

No. 2 size peas are peas that will pass through a screen of 10/32-inch mesh, but not through a screen of 9/32-inch mesh.

No. 3 size peas are peas that will pass through a screen of 11/32-inch mesh, but not through a screen of 10/32-inch mesh.

No. 4 size peas are peas that will pass through a screen of 12/32-inch mesh, but not through a screen of 11/32-inch mesh.

No. 5 size peas are peas that will pass through a screen of 13/32-inch mesh, but not through a screen of 12/32-inch mesh.

No. 6 size peas are peas that will pass through a screen of 14/32-inch mesh, but not through a screen of 13/32-inch mesh.

No. 7 size peas are peas that fail to pass through a screen of 14/32-inch mesh.

Suggested Label Weights (Net Weight)

Peas (Sp.Gr.1.05)		Lbs.	Ozs.
8Z Tall	211 x 304	.	8½
No. 1 Picnic	211 x 400	.	10½
No. 1 Tall	301 x 411	1	.
No. 303	303 x 406	1	.
No. 2	307 x 409	1	4
No. 3 Cylinder	404 x 700	3	2
No. 10	603 x 700	6	9

There are several patented processes designed to retain the natural green color of fresh peas. Most of the processes are similar and the procedure for the Blair Process follows to show a typical method.

* (1) Pretreatment immersion of the peas in 2% sodium carbonate solution at well water temperature for 30 minutes.

(2) Blanching in a solution containing 3¾ ounces of calcium oxide per 100 gallons of water.

(3) Brining with a sugar-salt solution containing 13½ ounces of magnesium oxide per 100 gallons of water.

(4) Processing by the "short-high" method (at 260° F. with a four minute come-up) followed at once by cooling to 70° F. or lower.

(5) Storing in a cool warehouse held at 55° F. or lower until distributed.

CHILI PEPPERS, OR PIMIENTOES (Capsicum Annum)

Both the green and red are used for canning. All peppers are graded for size, the 2-inch are No. 1; 1¾ to 2-inch graded as No. 2 and all below 1¾ inches are considered culls.

Each grade of peppers is handled separately, and conveyed to coring rooms where special machines cut a circular disc from the core end and remove the seeds and core by means of vacuum. The peppers are then placed on rods or arms called "cones" attached to an endless belt. They then pass through a furnace heated to a white heat, where they are exposed for a few seconds. The intense heat bakes or burns the skin which is then removed either by passing through brushes followed by spraying or as they pass through a cylindrical washer of the "squirrel cage" type, where the skins are removed. They are then conveyed to trimmers who remove and trim any skin, core, etc., remaining on the pepper, after which they are packed in cans.

Another method is to pass the peppers through a lye bath which removes the skin without affecting the color or flavor. This method is economical and effective. Dissolve 2 ounces of lye in one gallon water, and bring to a boil and then drop in the peppers and boil for 6 minutes. Then pass them through a bath of cold water and thoroughly rinse to remove any clinging or loose skin. They are then packed solid into cans.

A new method for removing the skins is to convey the pepper to a roaster which is highly elevated at the intake end. As the peppers roll automatically down the inclined furnace, about 65 feet long, and heated to 3000° F. which takes about 8 seconds, they are caught and washed thoroughly, stemmed, trimmed and later packed.

A third method used to remove the skins is to pass the washed peppers through a bath of hot oil. Some use cottonseed and others use a low grade engine oil. The oil is heated to 450° F., the pimientoes remaining in it for a few minutes, after which they are drained, and washed as free of the oil as possible. The loosened skin is removed, trimmed, cored, and seeded by trimming knives.

Recommended Processing Temperatures and Times

Peppers, including Pimientos

Pressure cooks adequate for sterilization may render these products unmerchantable. Under proper control, these products may be acidified to a point where they are no longer low-acid and then may be effectively processed in boiling water. This procedure should not be followed without consulting a research laboratory connected with the canning industry.

Suggested Label Weights (Net Weight)

Pimientos		Lbs.	Ozs.
4Z Pimiento	211 x 200	.	4
7Z Pimiento	300 x 206	.	7
No. 300	300 x 407	.	14
No. 2½	401 x 411	1	12
No. 10	603 x 700	6	13

* From the Research Bulletin, American Can Co., September 1944, No. 6.

POTATOES, WHITE (Solanum Tuberosum)

Canned white potatoes are becoming increasingly popular with consumers because they are easily and quickly made ready for serving.

The potatoes may be sliced, diced, or small whole and are usually packed in a salt brine. Not all varieties of potatoes are firm enough to can so preliminary tests should be made on samples intended for canning.

Peeling is best accomplished with a rotary vegetable peeler. The peeled potatoes should be placed immediately in a weak salt solution to prevent discoloration.

Uniform sized potatoes should be canned in each can to prevent a poor appearance of the finished product. A hot 1-2% brine is filled to cover the potatoes.

Recommended Processing Temperatures and Times

Potatoes, White, sliced or whole, in brine

Can name	Dimensions	Retort temp. Deg. F.	Time Min.
No. 2	307x409	240	30
		250	20
No. 2½	401x411	240	35
		250	25
No. 10, except sliced	603x700	240	45
		250	30
No. 10, sliced	603x700	240	50
		250	32

Potatoes, White, sliced or diced, in brine

Jar size	Dimensions	Retort temperature Deg. F.	Time Min.
303	303x411	240	40
		250	30
2½	401x414	240	45
		250	35

Potatoes, White, small whole, in brine

303	303x411	240	35
		250	25
2½	401x414	240	40
		250	30

Suggested Label Weights (Net Weight)

Potatoes, White		Lbs.	Ozs.
No. 2	307 x 409	1	4
No. 2½	401 x 411	1	13
No. 10	603 x 700	6	6

PUMPKIN (Curcubita Pepo)

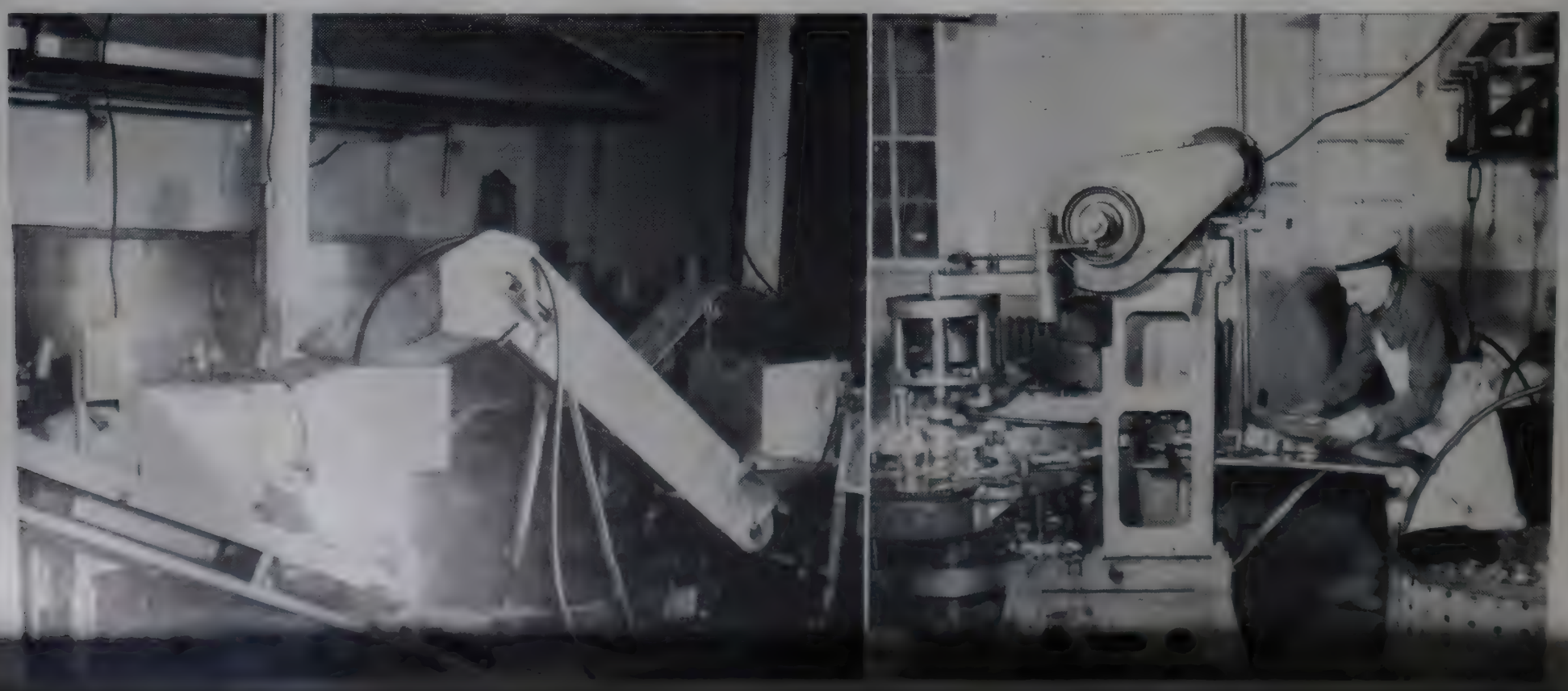
Only a hard, sweet variety of even texture and ripened evenly should be used for canning. After soaking or washing, they are cut into pieces or chunks by means of knives or sharpened implements. Next the pieces are run through a revolving washer which removes the seeds and fiber. The pieces are then placed in a steam box and heated until soft. This requires about 15 or 20 minutes at 240° F. When a steam box that can be operated at high temperature is not available, the pumpkin may be packed in any tank that can be equipped with perforated pipes along the sides and bottom. However, this system is not so good as a pressure cooker because the steam is condensed, and trapped into the tank, thus adding more moisture which must be removed later. Another system is to pass the cut pieces of pumpkin on an endless belt through a steam box about 30 feet long where they are exposed to live steam.

The steamed pieces are then run through a pulping machine which removes the skin and remaining seeds and fiber. If the pulp is of a thin consistency, then it should be cooked in kettles equipped with agitators (or vacuum pans) to remove the excess moisture before canning.

Vacuum equipment produces an exceptional quality retaining the rich golden color and fresh pumpkin flavor. Of course, the installation and operation of such a system is so expensive that the average packer cannot afford to install such a method. Often where tomato paste is packed, the tomato season is about over when the pumpkins are ripe and ready for packing, so that the same vacuum system can be utilized for this product.

After wilting the pumpkin, it is often placed in a hydraulic press to remove excess moisture, but this method removes the "juice" and leaves the pulp. The juice contains the sugar, soluble minerals and the flavor so that this method produces

Slicing machine, below, slices potatoes thick enough to hold their conformation after processing. Slicing is followed by screening to sort out small pieces of sliced potato. A hot 1 to 2% brine (at about 210°) is added to potatoes during filling. Then they are sealed and processed at temperatures ranging from 240 to 250°F in retorts.



a product devoid of the real pumpkin flavor, just as the removal of the "water" (juice) from tomato pulp by separation removes the real characteristic tomato flavor.

There is a pumpkin press on the market which removes part of the moisture without the removal of the soluble solids.

Squash is often mixed with pumpkin to make a dry pack. Cornstarch has been used to produce a drier pack and one that will not "weep" or "bleed" when the pumpkin is placed on a plate. The addition of corn starch, would of course, have to be stated on the label in large type and in a conspicuous place on the front of the label.

Recommended Processing Temperatures and Times

Pumpkin or Squash

Can name	Dimensions	Initial temp. Deg. F.	Retort temp.	Time Min.
No. 300	300x407	160	240	65
		180	240	60
		160	250	55
		180	250	45
No. 2	307x409	160	240	80
		180	240	70
		160	250	65
		180	250	60
No. 2½	401x411	160	240	105
		180	240	95
		160	250	85
		180	250	75
No. 10	603x700	160	240	210
		180	240	190
		160	250	185
		180	250	165

Pumpkin or Squash

Jar size	Dimensions	Initial temperature Deg. F.	Process time at 240° F. Min.	Process time at 250° F. Min.
303	303x411	160	85	70
303	303x411	180	80	65
2½	401x414	160	125	105
2½	401x414	180	110	90

Suggested Label Weights (Net Weight)

Pumpkin		Lbs.	Ozs.
No. 303	303 x 406	1	.
No. 2	307 x 409	1	4
No. 2½	401 x 411	1	13
No. 10	603 x 700	6	10

SAUERKRAUT

To pack a good kraut, it should be placed in the cans with as near the natural flavor as possible.

The general procedure has been to place the kraut in a tank equipped with perforated steam pipes and add either water or some of the kraut juice and heat; then pack it into cans and add either water or salt brine, exhaust and sterilize.

The addition of kraut brine is preferable as it does not detract from the natural flavor, whereas water does give the product an insipid flat taste.

Heating with open steam lines, drives off some of the aroma or bouquet, also some of the volatile acid, introduces water, and reduces the fixed acid and flavor.

Kraut juice placed in a tank with perforated steam pipes and heated before the addition of the kraut showed the following:

	Juice Before Heating	After Heating	Loss
Salt	12.0°	10.0°	2.0°
Acidity (lactic)	1.098%	0.88%	0.218%

There are several methods used in canning kraut:

1. Place the kraut in a tank and cover with boiling water in order to loosen the solid flakes, partly cook, and make it light and stringy. After it is well heated, fork the kraut to a table where it is drained before filling into cans. Pack solid and then cover either with hot water or a 2% salt brine.

This method produces a flat insipid product with very little or none of the pleasing sour kraut taste.

2. Use the drained kraut juice, heat it to boiling, and then add the kraut and fork it over until it is quite hot. Then place it on packing table, or in an automatic filler and collect the drained juice which can be used to "top" the cans. After filling into cans, add some of the natural kraut juice that has been heated to between 170 and 180° F. Exhaust for about 8 minutes, preferably in a hot water exhauster.

Plain cans have been used for kraut but enameled cans reduce the loss due to hydrogen springers, but the flavor and color are not quite as good as the kraut packed in plain cans. The action of the acid on the tin gives the kraut a certain "snap" or tart flavor which is not present in the kraut in enameled cans. Due to high acid and its action—"C" enamel should not be used in canning kraut.

Should there not be sufficient kraut juice to fill the cans, a hot 2-2.5% salt solution may be added, or else hot water. If the acidity of the brine is approximately 1.8% and salt 14-15° then water can be added without affecting the flavor greatly, but if the acidity is 1.0-1.2% and salt 10-12°, then the addition of water will affect the flavor and should not be used. Preferably a brine of the same acidity and salt content should be used. A brine may be made by adding lactic acid and salt to water, but it is not as satisfactory as original kraut juice.

A kraut that has fermented to only 1.0% acidity has not cured enough and should not be used for canning; one that has an acidity of 1.2-1.4 with a salt of 14° will give better results. There seems to be a balance or ratio of salt to acid where the product is neither too salty nor too sour. An acidity of 1.2% will carry a 12° salt while a 1.4% acidity seems to take a 14° salt nicely.

Kraut is one of the easiest vegetables to sterilize because of the relatively high acidity and salt and also the fact that the organisms present (which are usually non-spore bearing) are easily destroyed by low temperatures, making it easy to handle notwithstanding the fact that it is a tight pack.

As the thermal death point of the lactic acid bacteria is about 140° F. and that of yeast is 145-150° F., any temperature exceeding 150° F., should be effective.

SPOILAGE:—In sauerkraut spoilage may be caused by understerilization, especially when the acidity is below 1%. It can also be caused by the action of the lactic acid upon the container with the liberation of hydrogen. Excessive fill, preventing the proper penetration of heat, may cause understerilization and later fermentation.

The cans are often given a light seal or crimp after filling before passing through the exhaust box. This prevents spilling of juice and rising of the kraut above the sides and yet permits entrapped air to come out.

If the filled cans of kraut pass through an exhaust box that will heat to over 160° F. (in the center of the can) it should not be necessary to even sterilize. Some plants do not sterilize after passing the cans through an exhaust, but the kraut is heated to not less than 160° F. before capping.

However, for those who wish to take an extra precaution, sterilize:

No. 2 cans 15 minutes at 212° F.

No. 2½, and 3 cans 25 minutes at 212° F.

No. 10 cans 40 minutes at 212° F.

Never process above 222° as it will have a strong burned

cabbage taste. An open bath at 212° F., is better.

In handling kraut, eliminate as much as possible the addition of water from the steam lines used in pre-heating and in siphoning the juice, because any dilution reduces the acidity, salt and natural flavor, and produces a flat insipid product. It is preferable to heat the juice and kraut with closed coils or else in glass lined jacketed kettles, using motor-driven pump to elevate the brine rather than a steam siphon. The greatest reduction in the brine occurs in the pre-heating tank and in siphoning with very little loss in passing the cans through the exhaust.

A good canned kraut should show an acidity of not less than 1.25% and 12° salt.

Suggested Label Weights (Net Weight)

Kraut (Sp. Gr. .99)		Lbs.	Ozs.
No. 303	303 x 406	1	.
No. 2	307 x 409	1	3
No. 2½	401 x 411	1	11
No. 10	603 x 700	6	3

Minimum Drained Weights:—No. 95—14 ozs., No. 1 tall—13 ozs., No. 300—12 ozs., No. 303—13 ozs., No. 2—16 ozs., No. 2½—23 ozs., No. 10—80 ozs.

Definition

Canned Sauerkraut is the product obtained by the full fermentation of sound, clean, shredded cabbage to which salt has been added, contains not less than 1 per cent of acid expressed as lactic, packed in hermetically sealed containers, and sterilized by heat.

SPINACH (Spinacea Oleracea)

CLEANING:—After trimming, etc., the spinach may be cleaned before washing by passing through a tumbler cylinder, where some of the loose sand, dirt, etc. may be removed, or the spinach can also be passed along a wire belt and shaken to remove the dirt. It is then passed to the washer.

WASHING:—Some dump spinach into large wooden tanks equipped with a perforated false bottom and filled with running water. The spinach is continually turned over in the water with a hay fork, or automatically with paddles, in order to loosen the dirt, and sand which falls through the perforations. This soaking tank is not used by some packers, but as spinach contains considerable sand this preliminary soaking aids greatly in reducing the amount present.

Next it is forked into a revolving cylindrical washer about 15 to 20 feet in length and 3 to 4 feet in diameter where it is sprayed vigorously as it passes through. This step requires 5 minutes. The speed and volume of water may be regulated according to the condition of the spinach.

It is quite essential that the spinach receive a thorough washing, as it rolls and tumbles; otherwise it may still contain considerable sand, and the more it is turned over and sprayed with large quantities of fresh water, the cleaner the final pack.

BLANCHING:—This process is used to soften leaves and remove the air from the tissue, thus making the tissue more transparent, so that the green is less obscured and gives the appearance of a greener color. The term "sets the color from a light green to a dark green" has been applied and is still being applied to the blanching of spinach by production line managers. We believe a difference in color, due to concentration of the color and also that the color is not removed from the leaves in the blanching, therefore such an expression "sets the color" Chlorophyl, the green coloring of vegetables is insoluble in water and does not leave the cells unless the cells are ruptured. The change taking place, or concentration

Inspecting spinach after it has been through dry tumbler to remove sticks, leaves, etc. Next: paddle and spray washers.

Blanching also removes the objectionable bitterness and gives it a preliminary cook and makes it easier to pack in cans so that the proper amount can be filled, to obtain the legal "cut out" weight.

The spinach may be blanched in perforated buckets, immersed in boiling water or in wooden tanks equipped with perforated steam pipes and false bottoms or it may be blanched by passing through boiling water in a revolving cylinder requiring from 3 to 5 minutes. Upon leaving the revolving blancher, it is caught in perforated tubs or buckets to drain off the excess water. The first two methods are objectionable on account of the labor involved in handling the buckets, the heating effect on the material, and close proximity to the steam. In the tubs or wooden box the matted condition of the spinach does not permit it to be agitated and it is therefore not uniformly blanched. It will still retain a great deal of water which is not removed as is done by the rotary blancher. A comparison of samples packed from rotary vs. box blanched gave "cut out" weights of 2 ounces heavier on a No. 3 can in favor of the rotary blanching. There is a tendency to blanch in live steam, and because the minerals are not removed, it has a sweeter taste, better flavor and color.

PACKING:—After blanching, spinach is dumped on tables where it is packed into cans. As the tables generally slope toward the center, the watery liquid accumulates and does not drain satisfactorily, consequently the first packed will be fairly dry and the last extremely wet. This method of packing shows lack of uniformity.

The blanched spinach may be placed on a perforated metal sheet elevated about 1½ inches above the table which permits it to drain quite dry, resulting in a more satisfactory pack.

An automatic filling device may now be used instead of hand packing.

The following weights of blanched spinach can be satisfactorily packed:

No. 2 can 15 ounces blanched spinach
No. 3 can 26 ounces blanched spinach
No. 10 can 76 ounces blanched spinach

Fresh spinach blanched 5 minutes and drained until the excess water runs off shows about the same weight as it did before blanching

BRINING, EXHAUSTING AND PROCESSING:—Cans are filled with a hot dilute salt brine made by dissolving 5 pounds of salt in 40 gallons of water. Often hot water alone is added, but salt brine improves the taste. Exhaust from 2 to 5 minutes for small cans and about 12 to 13 minutes for No. 10 cans. Cap and process.

Recommended Processing Temperatures and Times

Spinach and other greens

These cooks may not be adequate for the continuous cooker, and canners planning to use a continuous cooker should consult a laboratory connected with the canning industry.

Drained weight and net weight are of determining importance with spinach and other greens and must be controlled to insure that the retort process will carry the intended sterilizing efficiency. The maximum drained weight given can not be safely exceeded, and the net weight of contents should be at least that given for the respective sizes of can.

Since blanched spinach tends to become stratified horizontally in No. 10 cans, it is found that heat penetration is more rapid when these cans are processed on their sides rather than in a vertical position. It is strongly recommended, therefore, that No. 10 cans be processed in a horizontal position.

Can name	Dimensions	Retort temperature Deg. F.	Time Min.	Maximum drained weight Ozs.	Minimum net weight Ozs.
8Z Tall	211 x 304	252	35	6.25	7.75
No. 1 (Picnic)	211 x 400	252	35	8	10
No. 1 Tall	301 x 411	252	35	11.5	15
No. 2	307 x 409	252	45	14.5	18
No. 2½	401 x 411	252	50	21	27
No. 3	404 x 414	252	50	24	31
No. 10	603 x 700				
Horizontal		252	60	66	100
		240	100	66	100
Vertical		252	75	66	100
		240	130	66	100

Suggested Label Weights (Net Weight)

Spinach (Sp. Gr. .98)		Lbs.	Ozs.
8Z Tall	211 x 304	.	7¾
No. 1 Picnic	211 x 400	.	10
No. 1 Tall	301 x 411	.	15
No. 303	303 x 406	.	15
No. 2	307 x 409	1	2
No. 2½	401 x 411	1	11
No. 10	603 x 700	6	2

Minimum Drained Weights:—No. 2—13 ozs., No. 2½—19 ozs., No. 10—60 ozs.

SUCCOTASH

This is a blend of either lima beans and corn or green beans and corn. The corn and beans should be prepared for canning and then mixed thoroughly at the rate of one pound of beans and one and one-half pounds of corn. Fill into cans at 190° F.

Recommended Processing Temperatures and Times

(Same as Corn, Cream Style)

Suggested Label Weights (Net Weight)

Succotash (Sp. Gr. 1.08)		Lbs.	Ozs.
8Z Tall	211 x 304	.	8¾
No. 1 Picnic	211 x 400	.	11
No. 1 Tall	301 x 411	1	.
No. 303	303 x 406	1	.
No. 2	307 x 409	1	4
No. 10	603 x 700	6	12

The following mixtures of vegetables in canned succotash shall conform with the proportions indicated:

Cream-style corn and snap beans
Cream-style corn and lima beans (fresh or frozen)
Cream-style corn and lima beans (dry, "soaked")
Cream-style corn, snap beans, and tomatoes
Cream-style corn, lima beans (fresh or frozen), and tomatoes
Cream-style corn, lima beans (dry, "soaked"), and tomatoes
Whole-grain corn and snap beans
Whole-grain corn and lima beans (fresh or frozen)
Whole-grain corn and lima beans (dry, "soaked")
Whole-grain corn, snap beans, and tomatoes
Whole-grain corn, lima beans (fresh or frozen), and tomatoes
Whole-grain corn, lima beans (dry, "soaked"), and tomatoes

	Proportions by weight Not less than	Not more than
Corn	50%	87½%
Snap beans	25%	50%
Lima beans, fresh	12½%	30%
Lima beans, dry "soaked"	12½%	30%
Tomatoes	10%	30%

SWEET POTATOES (Ipomoea Batatus)

There are three types of potatoes used in canning, yellow, white, and yam; the yellow skinned makes the best appearance. The potatoes used are usually small, being about 1 to 1½ inches in diameter. There is no more convenient way of purchasing sweet potatoes, as the package is ready to use without the preliminary peeling and cooking.

In canning sweet potatoes, the general procedure is to place them in a steam chest from 9 to 18 minutes at 240° F. The time is varied depending upon the size and variety used.

The skins can then be easily removed by peeling or skinning. Pack them tightly into cans. As the pack is quite solid, they are exhausted from 6 to 10 minutes under full head of steam. Sugar syrup or 2% salt brine may be added.

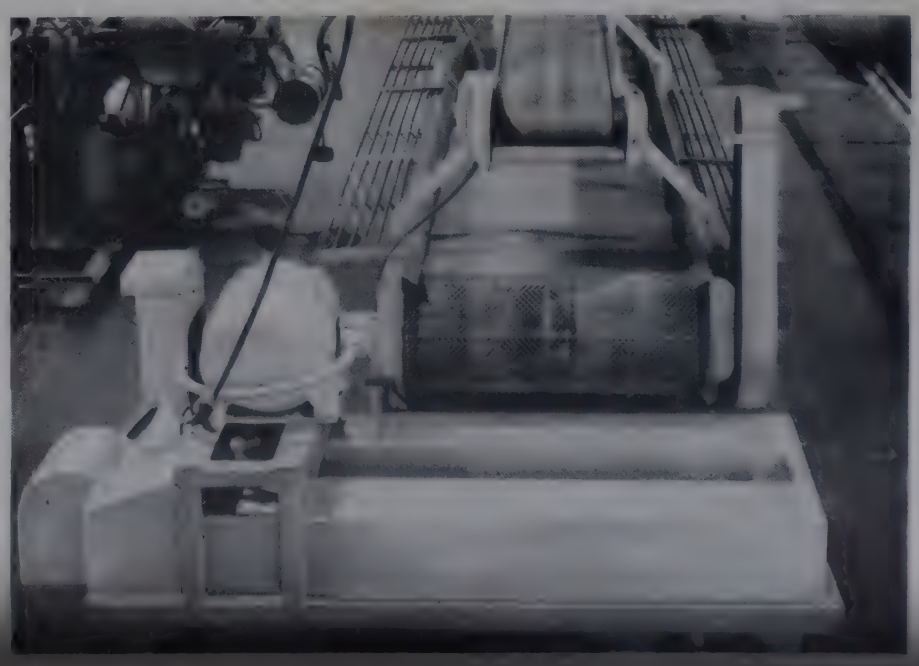
Recommended Processing Temperatures and Times

Sweet Potatoes, solid pack

These are the minimum processes that can be used with safety.

In view of lack of standardized canning procedure for other styles of sweet potatoes (asparagus style, vacuum

On this production line, after washing and inspection the spinach is run through the dicing machine in foreground.



pack, syrup pack, etc.), they should not be packed without directions from a research laboratory connected with the canning industry.

Can name	Dimensions	Initial temperature Deg. F.	Retort temperature Deg. F.	Time Min.
No. 2	307x409	80	240	110
		120	240	105
		150	240	95
		180	240	85
No. 2½	401x411	80	240	130
		120	240	120
		150	240	110
		180	240	95

Potatoes, Sweet, whole, in syrup (a)

Jar size	Dimensions	Retort temp. Deg. F.	Time Min.
303	303x411	240	35
		250	25
2½	401x414	240	45
		250	35

(a) These cooks do not apply to solid pack sweet potatoes. It is emphasized that the sugar used in the canning of this product should comply with the bacterial standards for sugar formulated by the National Canners Association.

Suggested Label Weights (Net Weight)

Potatoes, Sweet		Lbs.	Ozs.
Dry Pack			
No. 2	307 x 409	1	3
No. 2½	401 x 411	1	13
No. 10	603 x 700	6	6
Syrup Pack			
No. 2	307 x 409	1	4
No. 3 Vacuum	404 x 307	1	7
No. 2½	401 x 411	1	13
No. 10	603 x 700	6	6
Vacuum Pack			
No. 3 Vacuum	404 x 307	1	2

TOMATOES (Lycopersicum Esculentum)

The varieties of tomato used in canning depend upon the processor, location, soil, and climate. A certain variety may be well adapted and give good yields for one section, while in another may produce poor results.

Scalding properly is very important because upon this operation depends the yields and the rapidity with which the fruit is peeled.

After passing through the washer, the tomatoes are subjected to a good head of live steam for about 10 seconds, and then immediately sprayed with cold water to check the heating and cause a separation of the skin from the fruit. They are then distributed to the peelers who prepare the fruit for the cans. The fruit is handled as rapidly as possible as fermentation sets in shortly after being peeled.

PACKING:—Larger the canning plant, the more modern the equipment, with automatic method of handling from the time of the arrival until packed in cans.

Tomatoes are packed either by hand or machines. Hand-packed is used for special or fancy grade so the fruit will not be crushed. Tomato juice may be added to fancy tomatoes but none added to solid pack. It was the practice to strain the juice from the peelings of the tomatoes and add to the [illegible] or run the peelings through a homogenizing machine [illegible] filling cans. The addition of the strained juice is permissible, but the addition of the peeling juice must be stated on the label.

To obtain the strained juice the pans, buckets, or receptacles containing the trimmings were emptied to one point, where they are dumped on a vibrating screen, the juice being caught while the trimmings pass on to the homogenizing machine where the remainder of the juice is extracted and concentrated to be used or sold as Core and Skin (C. & S.) pulp, or else destroyed.

Unless the tomatoes are carefully sorted and trimmed the screened juice and homogenized core and skin pulp will not meet the U. S. microscopical standards for tomato products. The packing of this class of goods should be discouraged, because sooner or later the packer will get into trouble as a result of the high tests which are almost impossible to meet during the rush season, even by careful sorting and inspection.

The screened juice is often heated and added to the cans of tomatoes. It was the custom to use steam siphons to convey or elevate the pulp to the heating tanks or kettles, but as this method introduces water or condensed steam from the lines and reduces the juice considerably, it should not be used. As high as 15-20% water was often added to the juice due to condensed steam. The heating tank should be equipped with an agitator to prevent separation of the pulp.

The filled cans should be given a thorough exhaust before capping to minimize springers and aid in sterilizing. A long low temperature exhaust in water is better than a high short one in steam. Exhaust using water of about 100° F.

No. 2 cans	3 minutes
No. 2½ cans	4 minutes
No. 3 cans	4 minutes
No. 10 cans	10 minutes

PROCESSING:—Time and temperature will vary according to the method used, quality of tomatoes, as well as the manner of packing. The following are approximate time and temperatures used: Open Bath 212° F. Agitator Cooker 11 r.p.m. 212° F.

Size Can	Ordinary Packing				Firm and tightly packed	
	Water Cooled	Air Cooled	Water Cooled	Air Cooled	Water Cooled	Air Cooled
2	45	35	12	7	13½	8½
3	55	45	15	10	18	13
10	90	70	20	15	25	20

From the variation in the time, it is readily seen that the

Semi-automatic filler. Cans move under disk with holes, tomatoes are dropped in. Cuts time in half over hand methods.

agitating cooker cuts down the time of processing. Some are even cutting the temperature to 180-190° F., but increasing the time slightly in order to improve color, flavor, and quality.

Water sterilization is preferable to steam because the cans come out of the retort much brighter and cleaner. It is also more economical, and does not produce a scorched flavor.

After processing, the cans should be cooled as rapidly as possible to prevent stack burn which may change the color from red to a muddy brown and to prevent a change in flavor.

Wholeness Factor Defined

"Whole" tomatoes are those in which each unit, regardless of weight, consists of a peeled, cored tomato in which the coring has been done in such a manner that the rounded contour of the stem end is not destroyed and no seed cavity has been more than slightly opened by trimming, and the general contour of the tomatoes has been preserved.

"Almost whole" tomatoes are those in which each unit, regardless of weight, consists of a peeled, cored tomato in which the contour of the stem end is not materially affected by excessive trimming or by other means; if they are cracked or split but not to the extent that there is a material loss of placenta (gelatinous mass filling the seed cavity) and seeds or serious opening into the seed cavity; and provided they can be restored to practically their original shape.

A "large piece" is a piece that weighs not less than 1½ ounces.

"Small pieces" are pieces that weigh less than 1½ ounces and do not pass through the screen during draining, as described under the factor of drained weight.

Drained Weight Defined

Drained weight is based on the percentage of tomatoes that remain on the screen after draining the sample for 2 minutes over a screen containing two meshes to the inch, the screen remaining in a slightly inclined position to facilitate the draining of the tomatoes. The wire of the screen is of uniform diameter of 0.054 inch, woven into square openings of 0.446 inch by 0.446 inch. Canned tomatoes packed in containers, the contents of which are less than 3 pounds, are drained over a screen of the above description, 8 inches in diameter. If the contents are 3 pounds or more, the tomatoes are drained over a screen of the above description, 12 inches in diameter.

Live steam, then cold water, loosen skins of tomatoes. Next peelers remove skins. Fruit must be handled rapidly.

"Capacity of container" means the weight of distilled water at 68° F. which the sealed container will hold.

The following table indicates the maximum head space allowable for commonly used containers.

Table of Drained Weights for Canned Tomatoes

Container size	Picnic	No. 303	No. 2	No. 2½	No. 10
Dimensions (in inches)	2-11/16x4	3-3/16x4⅜	3-7/16x4-9/16	4-1/16x4-11/16	6-3/16x7
Headspace*	8.8 (Ounces)	9.4 (Ounces)	9.7 (Ounces)	9.9 (Ounces)	13.6 (Ounces)
	7	10½	13	18¾	68¾
	6¾	10¼	12½	18¼	67
	6½	10	12¼	17¾	65
	7¾	11¾	14½	20¾	76½
	7½	11½	14	20¼	74½
	7¼	11	13½	19¾	72¼
	6¾	10½	13	18¾	69
	6½	10	12¼	17¾	65½
	6¼	9¾	12	17¼	63½
	6	9¼	11¼	16½	60¼
	5¾	8¾	10¾	15½	56¾
	5½	8½	10¼	14¾	54¾

* Maximum head space allowable (measured from top of double seam in 16ths of an inch)

Suggested Label Weights (Net Weight)

Tomatoes (Sp. Gr. 1.02)	Lbs.	Ozs.
8Z Tall.....211 x 304	.	8¼
No. 1 Picnic.....211 x 400	.	10
No. 1 Tall.....301 x 411	.	15½
No. 303.....303 x 406	1	.
No. 2.....307 x 409	1	3
No. 2½.....401 x 411	1	12
No. 10.....603 x 700	6	6

TOMATO PRODUCTS

One of the important branches of the food preserving industry is the manufacture of tomato products. Pulp, paste, catsup, chilli sauce and special sauces are embraced under this heading. Canned tomatoes and canned tomato soups are treated under their respective headings.

A statement of the definitions and standards for tomato catsup, paste, and pulp will simplify subsequent discussion.

Catsup, ketchup, catchup, is the food prepared from the liquid obtained from mature tomatoes of red or reddish varieties. Such liquid is obtained by so straining such tomatoes, with or without heating, as to exclude skins, seeds, and other coarse or hard substances. It is concentrated, and is seasoned with sugar or a mixture of sugar and dextrose (refined corn sugar), salt, a vinegar or vinegars, spices or flavoring or both, and onions or garlic or both. When sealed in a container it is so processed by heat, before or after sealing, as to prevent spoilage.

Concentrations of Canned Tomato Paste

Heavy Concentration means that the canned tomato paste is such that the salt-free tomato solids content is 33% or more.

Medium Concentration means that the canned tomato paste is such that the salt-free tomato solids content is 29% to 33%.

Light Concentration means that the canned tomato paste is such that the salt-free tomato solids content is 25% to 29%.

Tomato puree (pulp) contains not less than 8.37%, but less than 25%, of salt-free tomato solids.

Concentration of Canned Tomato Puree (Pulp)

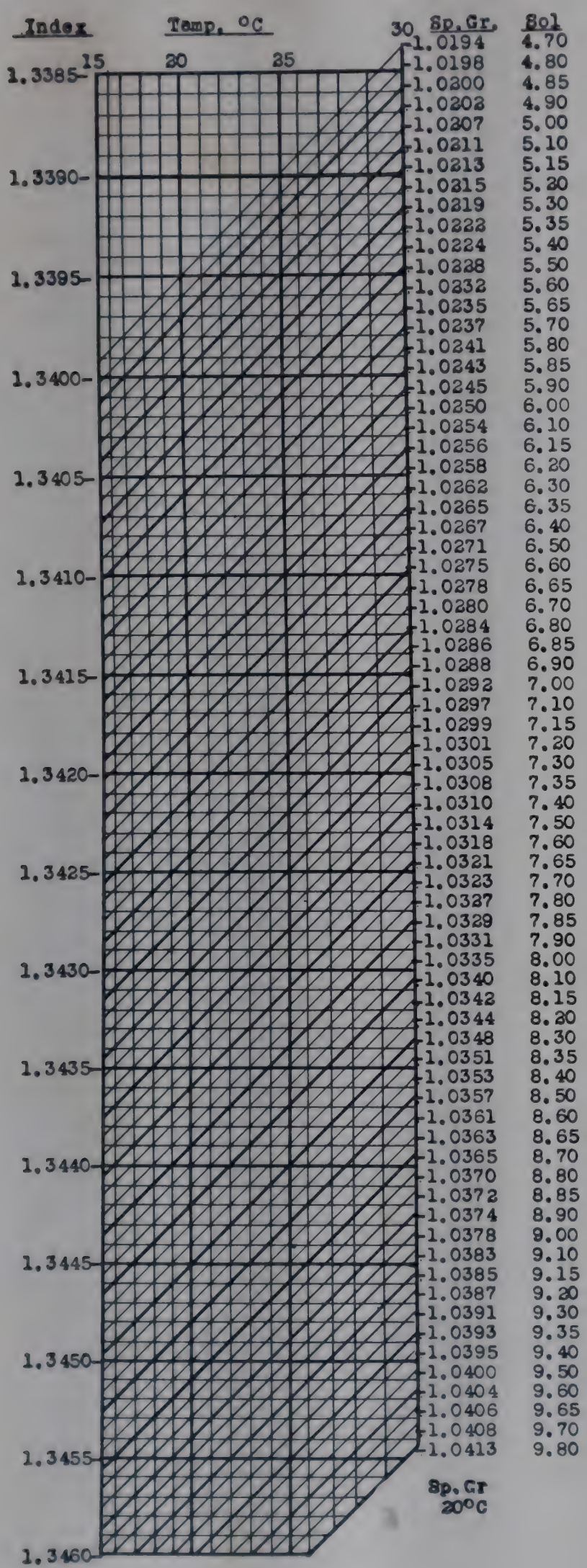
Heavy Concentration means that the canned tomato puree (pulp) contains 12% to 25% of salt-free tomato solids.

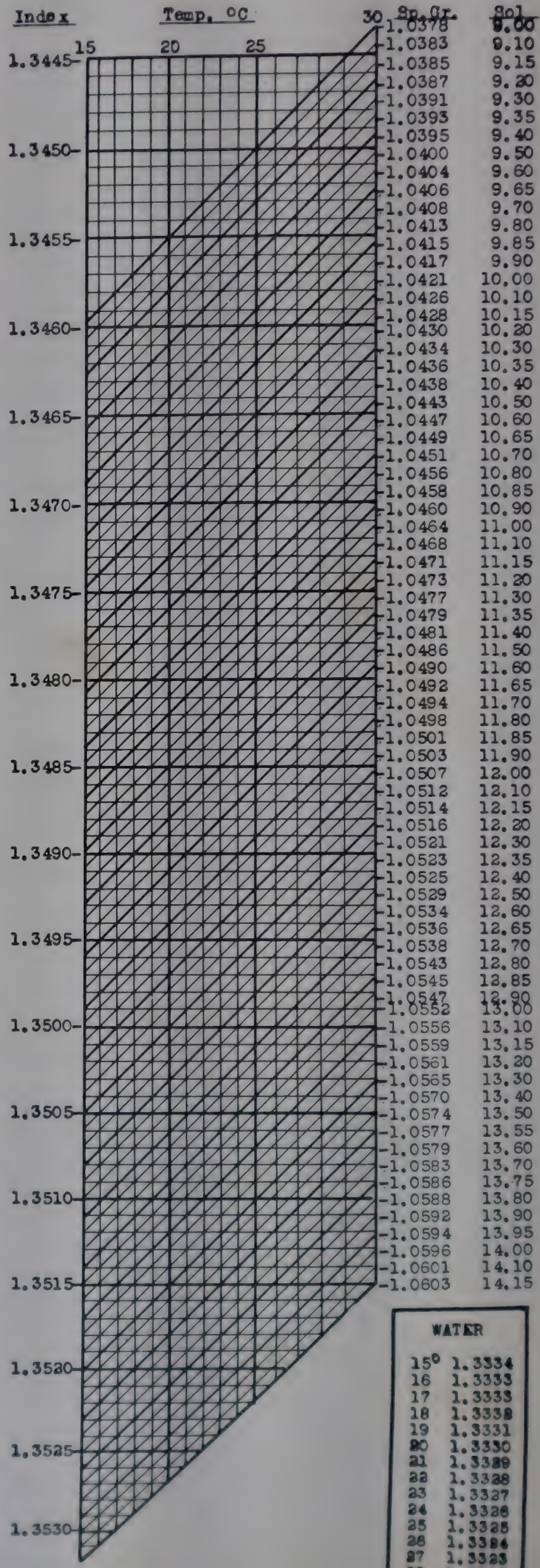
Medium Concentration means that the canned tomato puree (pulp) contains 10.7% to 12% of salt-free tomato solids.

Light Concentration means that the canned tomato puree (pulp) contains 8.37% to 10.7% of salt-free tomato solids.

The proper variety that should be used for manufacture of tomato products, is a problem that the manufacturer must

RELATION BETWEEN SPECIFIC GRAVITY (Sp.Gr.) OR SALT-FREE SOLIDS (Sol) OF WHOLE TOMATO JUICE OR PULP AND REFRACTIVE INDEX OF FILTRATE





WATER	
15°	1.3334
16	1.3333
17	1.3333
18	1.3332
19	1.3331
20	1.3330
21	1.3329
22	1.3328
23	1.3327
24	1.3326
25	1.3325
26	1.3324
27	1.3323
28	1.3322
29	1.3321
30	1.3320

From Abbe refractometer reading at left, follow horizontal line to right until it intersects vertical line corresponding to temperature of instrument. Then follow nearest diagonal upward to right and read off specific gravity at end of diagonal. (Solids determined by drying at 70°C in vacuo. Chart reproduced through courtesy of Heekin Can Co., Norwood, Ohio.)

settle for himself. First the product should represent the manufacturer's ideal and then the varieties should be chosen that will develop into that product when grown in the particular locality where needed. The latter precaution is to be emphasized because tomatoes which are ideal for a given purpose in one section of the country may show markedly different characteristics when the same seed is grown in another section. This has been found to be particularly true when highly developed varieties of eastern origin have been grown in other parts of the country in soils containing excessive amounts of nitrogen. Thick walls become thin walls and solid fruit becomes watery under these conditions. Also the plant usually grows very bushy with a lower yield of fruits.

Tomatoes for canning, catsup or chili sauce should be the thick-walled meaty tomato. For pulp to be sold on specific gravity only, the choice of a thin wall high specific gravity tomato will yield more cans of pulp per ton than the thick-walled tomato, but if the pulp is sold on the total solids basis, then the thick-walled meaty tomato will probably be more satisfactory as far as yields in cans per ton are concerned. It is assumed, of course, that factory control is rigid and accurate in the above discussion.

The first tomatoes from a patch are thickest walled and as the season advances, the walls become progressively thinner and the tomatoes more watery. Therefore, one must not be too hasty in forming conclusions about any given lot of tomatoes.

Color, flavor, shape, size, cracking, disease resistance, yield per acre, rate of maturity, amount of foliage, earliness or lateness are factors that must be considered in choosing type and variety to pack a specific tomato product.

For canning, or for pulp and paste manufacture, the deep red tomato of suitable physical structure is probably the best type, but for catsup and chili sauce for bottling the scarlet rather than deep red color is probably more desirable.

Fruits which are too small cannot be peeled economically, and although all other characteristics may be desirable they will find their greatest use in pulp, paste, or catsup. Those of suitable size for peeling will be necessary for canning or for chili sauce.

Cracked fruit must be watched by the manufacturer because of the possible formation of mold under the scar tissue. Some varieties exhibit greater cracking tendencies than others.

Foliage is important. Fruits of those varieties which possess very little foliage will sunburn or scald if grown in high altitudes or if exposed to intense heat and direct sunlight. Badly sunburned tomatoes are of very little value.

It is recommended that the State Agricultural Experiment Stations be consulted freely on these problems.

SOILS AND FERTILIZERS:—The best soils for growing tomatoes are sandy and clay loams. Low lands subject to flooding, poorly drained, and sour soils are to be avoided. Likewise alkali and "black alkali" soils should be avoided. Soils containing plenty of organic matter are able to retain moisture in dry weather. Hence it is well to have tomatoes follow a clover or other cover crop which has been plowed under. The tomato is a dry weather plant but it needs a certain amount of moisture.

The ground should be plowed six to eight inches deep unless this brings up the subsoil. It should be worked well and mellow before planting. Tomatoes, like all other plants, need food either obtained directly from the soil or from added fertilizers. Well fed plants will yield abundantly under normal weather conditions. If manure is used it should be distributed at the rate of 10 tons per acre, but if commercial fertilizer containing 16% acid phosphate is used, it should be used at the rate of about 400 pounds per acre.

Young tomato plants being received for transplanting on canner's acreage. Crated plants should be shipped refrigerated.

PLANTS:—Plants should be strong and healthy, about nine inches high and stalky—not spindly. Those grown in one section and transplanted to another often grow better and give better yields than those grown in the immediate vicinity, because they can be brought to proper maturity on time. In planting, plenty of space should be allowed between rows for the plants to spread as well as for the pickers to gather the tomatoes. Usually from three to four feet is the distance allowed between rows.

Setting plants 4 by 5 feet apart will require 2,700 plants per acre, and as the loss in growth and development is about 10%, it will be necessary to grow 2,970 plants per acre.

Transplanting is done either by hand or by transplanters. For hand work the field is first marked out and then, when the soil is suitably moist, or just before a shower, the grower sets them out. The same procedure should be followed for machine planting unless the transplanter works from a wire as with planting corn seed.

In order to obtain high yields, it is advisable to use a plant starter solution. This is true whether transplanting is done by machine or by hand. Starter solutions are effective for improving growth and increasing yields, particularly early yields, due to the stimulation of root development by providing a supply of immediately available plant nutrients. The best starter mix is one that is completely soluble. This is especially important if transplanting is to be done with machinery. A completely soluble mix will have no sludge, when in solution, and consequently will not clog transplanting equipment.

One of the best plant starter mixes has an analysis of 10-52-17 and is recommended for setting out tomatoes, as well as all other transplants. Growers in many parts of the country have used the 10-52-17 starter mix with success. This product has the desired proportions of nitrogen, available phosphoric acid, and water soluble potash to overcome the shock of transplanting and to stimulate rapid root development. Thus, earlier yields are assured and a minimum of plant replacements are necessary.

Most growers still use the hand method of setting out plants, and because it is a back-breaking job, they are often likely to omit two very important operations. First: plants should be set in deep. Roots and stem as far as the branches should be covered with soil. This will make for a large root system and it will not be blown out or washed out by storms shortly after transplanting. Second: plants should be firmed in by packing soil tightly around the plant. A safe rule to follow is to pack tight enough so that the stem will break if one

tries to pull the plant out. It is possible to overdo the packing in, but most growers err on the other side.

As the plants develop they should be cultivated close to the stem at first, then farther away so as not to injure the plant and roots. Weeds should be kept down by thorough cultivation. Weeds not only absorb the moisture from the field, but may spread plant diseases.

Some processors when contracting for tomatoes, instead of specifying a certain number of acres, will specify a tonnage basis per acre, taking a good average yield as their basis. This seems to be the only true basis as far as protection to the processor is concerned. It keeps the grower from flooding him with tomatoes when the contract price is higher than the market price and also prevents the grower from diverting a part of his crop when the market price is higher. The grower should be told that ripe tomatoes weigh more than green ones and their income from ripe fruit wil be greater. Careful inspection should be made of all shipments received and the growers of poor tomatoes eventually be eliminated.

DIRECT SEEDING:—Many canners are growing some of their tomatoes direct from seed. They contend that seed, when planted in a particular field or type of soil, will adapt itself in germination and plant development to that soil and its nutritional content. This eliminates the severe setback that a southern grown plant suffers. About one pound of seed is used per acre; this places the seed about an inch apart in the row.

GRADING:—Factories buy on three grades. Each load is inspected by removing tomatoes from different parts of the load before it is unloaded and the different grades separated, weighed, and the farmer paid according to the average grading. The farmer is being paid more for his tomatoes and the factories are receiving better tomatoes than ever before. Heretofore, the factories took in all kinds of tomatoes and it was often difficult to produce quality goods.

Tomatoes should not be grown year after year on the same field, rather the crop should be rotated. A contaminated field will keep on producing contaminated tomatoes until practically nothing but diseased plants are produced.

COLOR:—Red color is most desirable in tomato products. Nature has placed two colors in the tomato; one called lycopene which is the red color and other carotene or orange color. Weather conditions affect the development of these colors, and in order to produce the desirable red, it is necessary that there be sunshine with a warm atmosphere. A temperature of 68-85° F. seems to be the most desirable to permit the red to develop and predominate over the orange. When the weather is cold and rainy and the temperature is near 60-65° or above 90°, the pigment carotene develops and predominates, as these temperatures are not favorable to the development of lpcopene. If the temperature is extremely high and the growing tomatoes are exposed to the direct rays of the sun without being protected by the leaves, then the red color may not develop. If we could control the sunshine and warmth, then we could control the color. To a certain extent, this is controlled by growing tomatoes in warm climates where the soil and moisture conditions are also right.

During the ripening process, there is a slow change in the development of the different colors, the green chlorophyl gradually changes to a yellowish and these eventually are replaced more or less by red pigments.

Tomatoes thrive better during hot days and warm nights and thus produce lycopene or red color, whereas cool days and cold nights produce carotene or yellow color. The selection of certain varieties, care in fertilization and cultivation will also help the red color while the reverse will aid in the development of the yellowish pigment. Certain varieties never will produce a true red color; they are grown in the South and

Pallets loaded with lug boxes of tomatoes being handled outside cannery with fork lift truck. Tomatoes not immediately processed must be stacked outside so air can get to them.

rant, and table use and are of a pink color. One reason the California packer can produce tomato products of such excellent color is the temperature which aids greatly in the production of the red pigment.

SHIPPING AND HANDLING:—On account of the great volume of business it is often necessary for the processor to buy his raw material near the growing point and transport it to his factory for manufacture. Where the factory depends on local acreage and the tomatoes are hauled by wagons or trucks, care must be used to see that the tomatoes are packed properly in crates or hampers. Baskets holding ⅝ of a bushel (so-called peach baskets) are better than most crates as they are lighter, allow free circulation of air during shipment, will nestle into one another, and not take up much space when empty, and are more easily cleaned when emptied. Some factories send all empty crates and baskets along belts where they are sprayed and steamed to remove any clinging materials that would eventually contaminate good tomatoes. For peach baskets, a washer patterned after an ice cream can washer may be used quite advantageously. Crates used should be slatted to allow circulation of air and should not be so large as to be cumbersome and heavy to lift. Those who use crates have a tendency to make them too large. Care should be taken to pick the right quantity of raw material and not overfill the containers, thus crushing and spoiling the tomatoes which in turn will contaminate others.

In loading baskets into wagons, trucks, and cars, the best results are obtained by bracing every third row with cross strips. Where the load is built high, removable slatted racks or platforms may be placed several inches above each tier to permit air circulation. Tomatoes thus packed in cars stand shipping very well and arrive at their destination in excellent condition. Slatted stock cars are usually used and not regular box cars, which have no means of air circulation and cause the tomatoes to spoil quickly. Refrigerator cars, iced or with the ventilators open are sometimes used. In certain sections of the East, sailing boats are utilized to transport tomatoes

they heat up and spoil quickly, due to lack of ventilation unless the haul is a very short one.

Experience has shown that ripe tomatoes will not stand long shipping especially in warm or hot weather, therefore, care must be exercised in selecting the tomatoes depending upon length of time they will be in transit and weather conditions. Tomatoes that require about 18 to 24 hours to be delivered to the plant should be slightly red when picked and by the time they reach their destination and worked into finished goods they will have ripened to about the right color. If they are shipped when ripe and have a good color, they will arrive in very bad condition. Special care should be made by the inspector to reject tomatoes with a great amount of rot, and mold as well as bruised and off color fruit.

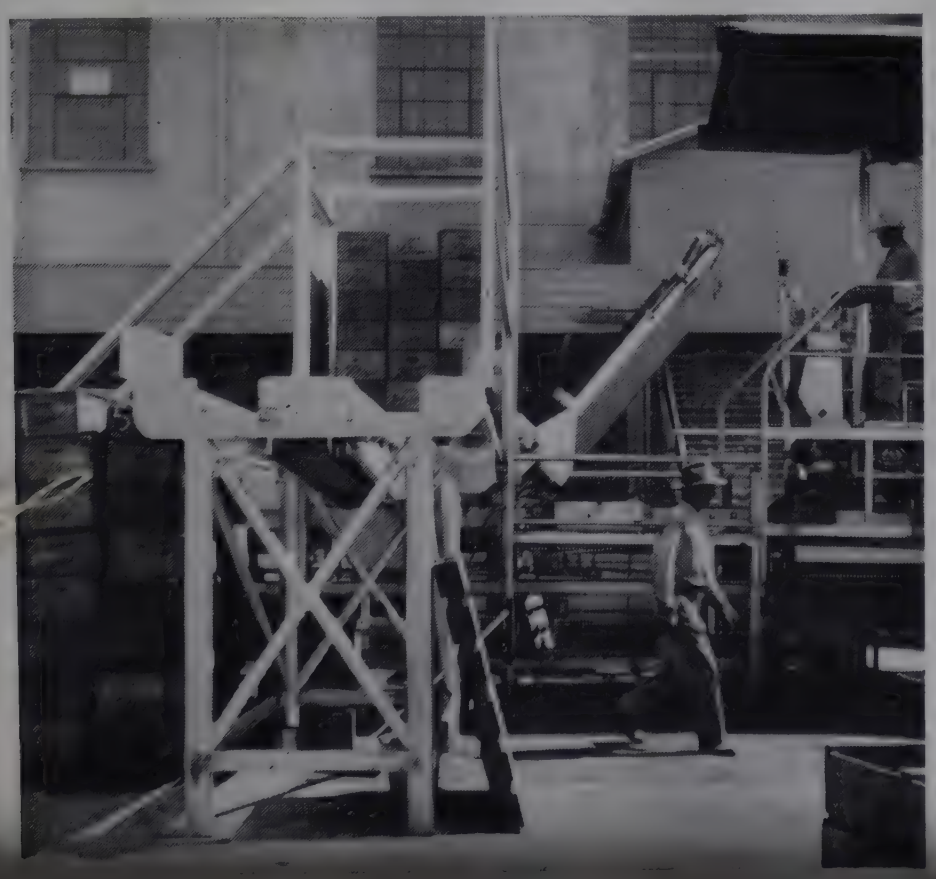
RECEIVING TOMATOES is a very important job at every factory or receiving station, but it is a task nobody relishes. A combination of firmness and diplomacy is required that not every man possesses. Every processor should adopt a definite policy towards receiving tomatoes and then adhere rigidly to this policy year after year regardless of crop conditions. Much of the unpleasant occurrences with growers at the receiving dock are traceable to laxity in enforcing contract provisions in some previous year. If sound red ripe tomatoes are wanted every year, then one should never accept anything less.

The efforts of the United States Department of Agriculture to establish tomato grades are aimed in the right direction and give the advantage to the conscientious grower and penalize the careless grower. But grades or other expedients will not take the place of backbone when it comes to enforcing contract provisions.

Another troublesome feature of the tomato receiving problem is that of the grower who is unable to control his help. The field workers pick any fruit which shows red color, and the grower seems powerless to stop him. This type of man is usually very good natured and full of promises to do better next time but ordinarily fails to fulfill his good intentions. Grading has to a great extent eliminated the picking of inferior or spoiled stock.

Tomatoes that are not processed immediately must be stacked outside on the receiving platform so the air can circulate between the hampers or crates. Very large plants, may be equipped with conveyors that transport the hampers from the unloading point to where they are to be stacked. Other conveyors may be so arranged to carry the hampers to the washing and sorting equipment.

Boxes placed on conveyor, foreground, are carried into position for dumping by automatic dumper in right background.



The tomatoes may be stored in tanks of cold water until ready for use. This water should be agitated and constantly changed to keep it fresh. They are removed by conveyors running into the storage tank. This soaking loosens the dirt, decayed spots, and softens the tissue surrounding the decayed portions so that they are easily removed. When the receipts are small, both early and late in the season, this method of holding has great advantage over allowing the tomatoes to accumulate in hampers until sufficient are on hand to make a run.

SOAKING AND WASHING:—To produce a clean pulp, it is necessary that it be as free from sand and decay as possible. Since all tomatoes, especially those grown on sandy soil, pick up sand either clinging to the surface of the tomato where it has been resting on or near the ground, or accumulating in the broken and healed tissue, care must be observed to free sand from the tomato. One washing will not remove it, but soaking followed by several washings will minimize the amount present. This especially applies to pulp to be used for tomato paste which is concentrated many times. Each manufacturer has his own ideas about soaking and washing and as long as the system is efficient, that is all that is necessary. There are many commercial types of washers that are quite efficient.

If any green tomatoes have been received they should be sorted out before they go to the washers. A tomato that is nearly ripe will sometimes ripen up by keeping in a warm, dry, well ventilated place. If the green ones are allowed to get wet, they will rot before they ripen. However, trying to ripen green tomatoes is a poor expedient that ends with loss more often than it does with profit.

Rotary washers or the various other tank washers which agitate the tomatoes by paddles or air bubbles help to remove sand and clay by rubbing the tomatoes together. Hard clay dried on tomatoes cannot be removed by mere washing unless preceded by soaking long enough to permit the clay to soften. A few plants give the tomatoes a second soaking followed by a spray wash after coming out of the first washer.

One of the most efficient washers on the market today is the rotary or squirrel cage washer. Originally it was a revolving cylinder open at both ends, made of a coarse mesh galvanized wire (about one-inch mesh) placed at a slight incline. The tomatoes passed through the cylinder while being sprayed with water from a series of outlets. The washer was a combination of rinsing and mechanical rubbing.

More recent developments of this washer have not changed it greatly except that the coarse mesh galvanized wire has been replaced by bars. One washer has round bars, another channel bars, etc. The rotary washer will not remove all of the mold notwithstanding statements to that effect but when properly installed and used will materially aid in getting rid of rotten portions of tomatoes. As used in a great many factories the water sprays are mere drizzles of insignificant value. The water pressure is frequently too small to force water from all the nozzles. Under such conditions, its value as a washer is trifling. Measurements of water pressures under these conditions will show less than 5 pounds per square inch, whereas the pressure requisite to produce maximum efficiency will be around ten times as much.

With spray pressures of from 40 to 50 pounds per square inch from small properly designed nozzles, the rotary washer becomes very efficient and the high pressure sprays will actually wash out a great deal of the soft rot and materially reduce trimming costs. Of course, this will require a great

Many production line managers favor bucket conveyor which circles peeling table and brings tomatoes to the fillers.

deal of water and some processors will be unable to utilize the greatest efficiency due to lack of an adequate water supply. A common fault in the use of rotary tomato washers is the poor aiming of the water sprays. They should be directly at the tomatoes and the less the water that is available the more important this becomes, but it is not infrequently observed that water from half the nozzle does not strike the tomatoes at all.

The speed of the rotating cylinder must be somewhat short of carrying the tomatoes clear around the periphery by centrifugal force. If run too slowly it will be overloaded with tomatoes and require a great deal of power for rotating, if it does not choke up altogether.

The rate of feeding should be great enough to produce a uniform flow of tomatoes on the sorting belt. Spasmodic feeding is to be avoided because it will result in spasmodic discharge of tomatoes, thus rendering sorting more difficult. The rotary washer will not act as a reservoir of tomatoes. They come out in much the same manner as they are fed into the machine.

SORTING:—One of the most important steps in manufacture is the proper sorting of the tomatoes after washing. Another is to keep a steady stream of tomatoes moving to the inspecting personnel. The proper rate should be about 2 bushels per minute for six efficient workers when the belt is traveling 25 feet per minute. If possible one or two men should be broken in and assigned to handle the dumping for the entire season. If carefully instructed first, they can handle this job quite efficiently.

Sorting belts vary as to length and width but they are usually from 18 to 24 inches wide and may be rubber, canvas, metal or rollers. Canvas belts stretch and are likely to slip and slide and require constant attention; they are also unsanitary as they allow the development of undesirable organisms. Good rubber belts and wire belts that are strong and durable can be used. They are sanitary, easily kept clean by hot water and steam and allow the dirt and rot to fall through into the drip pan underneath. The most recent is the roller belt which possesses all the advantages of sanitation possessed by wire belts and has the ability to turn the tomatoes over and over from one side to the other, thus rendering sorting much

The number of inspectors and rate of feeding will vary with the quality of the tomatoes and belt speed. When tomatoes are very bad, more inspectors are required and the

Too much stress can not be placed upon inspection by properly trained help. It is well to have one person supervise the sorting continuously and hold this party responsible. Young girls may work faster but as a general rule can not be kept at sorting like older women. To obtain proper results the sorting belt should be at convenient working height, located in a very light place or be adequately lighted. Frequently the washing and sorting equipment is installed outside the main plant on a covered platform. As the tomato season is usually over before cold weather this platform is seldom enclosed.

Inspectors can not be expected to remove mud and dirt from tomatoes. They must have clean material to work with, and unless plenty of water has been used and is available, it is useless to try to pack clean pulp, paste, or catsup.

It is not desirable to try to save good water by giving a preliminary washing with water from creeks, bays, rivers, or ponds, followed by a washing with pure water. Such surface water may be badly contaminated and endanger the health of workers as well as contaminate the product.

The methods of handling and inspecting are many, and for that reason it may be assumed that sorting has not yet become a standardized operation. It is useless to discuss the poor methods of sorting except incidentally. There are too many bad examples to render it necessary.

First of all let it be well understood that sorting and trimming are too distinct operations that can not be performed successfully by the same person. By separating the two functions, one can operate with fewer workers than by attempting to combine them. The sorters are to remove the objectionable tomatoes and have to work fast. The trimmers are to inspect tomatoes removed by the sorters, dump them if they are worthless or trim them if there is enough of value to warrant it.

A recent development of sorting belts is one in which the belt is divided longitudinally by metal partitions into three sections and arranged so that the unsorted tomatoes pass along the outer sections nearest the sorters. Rejected tomatoes are placed in the center section and conveyed to trimmers. Another type which achieves the same end with less fatigue to workers is arranged so that rejects are dropped into a small hopper at the side of the belt and find their way by gravity to a conveyor which takes them to the trimmers.

However, some of the most elaborate schemes have been abandoned for the old bucket plan which requires a little more help but is reliable and is furthermore free from a multitude of conveyors and elevators. In the bucket plan the sorters drop the rejects into buckets which are carried to trimmers seated at nearby tables. Here the trimmed tomatoes are dropped into buckets and later are sent to the final sprayers and are ultimately pulped.

To put the trimmed tomatoes into the rotary washer is not good practice as most of them will be washed away.

Nearly all sorting belts are too short. With average tomatoes three workers on a side per line are usually sufficient but there always comes the year when tomatoes are very bad and when anywhere from six to ten sorters on each side of the belt are needed; on short belts there may not be sufficient working space.

Four or five feet of belt per person on a side should be allowed which gives room for the worker and his buckets. When space permits, no belt should be less than 30 feet in length, although a great many factories try to get along with very much less. Some try to operate with only 6 feet and their history contains instances of seizures for high mold count.

Trimmers and sorters working side by side at the same belt have been used with moderate success. Trimming and sorting by the same workers is a failure. Separation of the two groups of workers and handling the rejects direct by con-

veyors or by hand is the best solution to the problem.

Trimming is usually a sedentary job and old women are frequently found engaged in this work whose eyesight may be very defective. They have been observed doing this work with such impaired vision that it is remarkable that they could see the tomatoes at all. Naturally trimming by such workers is very poorly done and instances are known where large amounts of rot have found their way to the pulpers by way of supposedly trimmed tomatoes. The absence of spectacles on very old ladies is sufficient reason to regard their vision with suspicion. They may be in possession of all their faculties of vision, but the odds are greatly against it. Old people are usually very sensitive about eyesight, and it may require much tact to learn the facts.

The trimmer should be thoroughly instructed as to her duties and taught that the sorter, who must work very rapidly, is instructed to throw out anything that looks suspicious. The sorter has no time to contemplate the peculiarities of a passing tomato with a judicial mind to determine whether or not it is a bad tomato or merely a scarred one. The opportunity of contemplation is delegated to the trimmer and here is another place where defective eyesight plays an important role. The trimmer with impaired vision, unable to detect anything wrong, feels that the presence of the tomato in her bucket is prima facie evidence of its badness and therefore cuts a liberal chunk out of what may be only a deformed or otherwise good tomato. If a good tomato is found it needs no trimming.

Sometimes amusing but most annoying hostility develops between sorters and trimmers that has its origin in lack of a clear understanding of the team work required of them. A trimmer of a dominant personality may cow a group of otherwise good sorters into practical uselessness when the foreman's back is turned in order to gain a respite from work. Undercurrents such as these will make either high costs or high mold counts, and are extremely hard for the management to detect. Considerable space has been devoted to them because as any good operator knows only too well, the sorting and trimming is a vital operation.

Green tomatoes which are wet should be dumped. They will rot before ripening.

The trimmer should be provided with a sharp knife and a short blade. A small hand operated emery wheel or knife sharpener should be handy to keep them sharp. **Dull knives make slow work and wasteful trimming.**

They should be informed that any rot that escapes their attention may be found years hence in the finished product via the microscope.

The trimmer cuts away any bad portions, cutting a half-inch into the solid part of the tomato because the molds have a root-like growth that extends beyond the zone of active rot. The person in charge of the sorting belt should be shown the different forms of rot as they are found so the sorters can be properly instructed. It is not uncommon to see the women cutting off green ends and scar tissue when they should have been devoting their time to proper trimming and sorting. One very common form of rot that has appeared in certain sections is black rot; this fungus is easily distinguishable as the black spot stands out in contrast to the red of the tomato. Stem rot is another form easily discernible by a black or brown spot or mark at the stem end; if a tomato having this rot is squeezed, the entire center may come out and leave nothing but the outer shell. Still another form of rot is the brown or speckled rot which appears as spots varying in size and number. These spots are concave and may be easily lifted out with a pointed knife, but they may appear so numerous that it is impossible to do any trimming, and the entire tomato must be discarded, otherwise the finished product will not pass inspection. White mold growths are easily distinguished, and soft water spots (blisters) are quite often broken by washing and tumbling, but it may be necessary to trim around the edge of the broken skin.

A long belt is better than a short one that is so crowded that none of the help work efficiently. A tumbling arrangement should be installed so that the tomatoes are turned over at least once; this permits the sorters to pick out bad ones that would otherwise pass and go into the pulp.

SCALDING:—Just before going to the pulpers, if the cold pulping method is used, the tomatoes should pass through a scalder which has the purpose of loosening the skin so that the meat does not cling to it. The scalder may be omitted but the yield will be lessened by its absence and the pomace will have about 20% more moisture (which is tomato juice) than it would have were it properly scalded.

Good red ripe tomatoes properly washed and trimmed are the indispensable basis for any tomato product. For all tomato products except chili sauce, the next operation is pulping. From this point on, very little can be done to improve quality. Quality may be lost subsequently through mishaps or mishandling but it can not be improved.

Pulp is usually made by two processes, one is called the hot pulp method and the other one called the cold pulp method. Both processes have merits as well as demerits and it is often a matter of personal opinion and judgment as to which gives the better results.

COLD PULPING:—The tomatoes after leaving the washers and sorting belt are scalded and run through a grater or grinder to disintegrate them before passing through the cyclone machines or pulpers.

This preliminary grinding may prevent the choking of the pulper and permit a steady uninterrupted feed. If the tomatoes are run through a pulper and then through a catsup finisher, a superior pulp results, although the yield is lessened. One cyclone machine may remove only stems, skins, seeds, coarse fiber and scar tissue whereas, finishing before working through a finer screen will remove any small unripe seeds, fiber, etc., not taken out by the first machine, thus producing a clean, smooth, well-colored pulp with a good tomato flavor.

The yield of juice by the cold pulp method may not be quite as great as by the hot one but the flavor should be better and the color about the same. It is thought that the color cells of the tomato lying in great abundance next to the skin are more easily separated after cooking, but if the tomatoes are properly scalded and the machines are adjusted properly, there is very little color left adhering to the skin. In cooking if any stems are present, tannin is introduced which may later affect the color. Cold pulp method will not introduce condensed steam nor iron from the steam line.

HOT PULP METHOD:—The tomatoes from the sorting belts either whole or chopped are conveyed or dumped into large glass lined or stainless steel tanks holding 500 to 1000 gallons. The tanks have concave bottoms with a large draw off valve for emptying quickly. They are also equipped with open steam lines forming a cross in the bottom, and as soon as the pipes are covered with tomatoes, the steam is turned on and the cooking continued until all the tomatoes in the tank are disintegrated, after which they are run through two cyclones equipped with coarse and fine screen. This usually takes from 20 to 30 minutes.

One of the main objections to the hot process is the quantity of pulp always on hand, and in case of a serious breakdown in the succeeding steps, it may mean a great loss due to spoilage. In the cold method there is very seldom more than one batch of pulp ahead. Too, the hot method may introduce large quantities of condensed steam, especially if the cookers are at a great distance from the boiler, unless the line is well "bleed" or preferably trapped. This excess of

water must be removed by extra cooking which adds to the fuel bill. Iron in the form of scale may be blown into the tomatoes and later cause discoloration and bitterness. Cooking will loosen the vegetable gums and any pectin, dissolves them and seems to add more stiffness to the pulp.

TOMATO POMACE:—The skin and seeds of the tomato are usually hauled away to a field, dump, or a disposal plant. On account of the rapidity with which it spoils, giving an offensive odor, this waste must be quickly disposed of. In Italy where many factories are in close proximity, this waste is collected at the various plants and shipped to several central points where the oil is extracted from the seed and the residue used for fertilizer or cattle food. The oil is refined and may be used for cooking, eating, or soap making. The Italian tomato is pear shaped and in proportion to size contains more seeds than American varieties, consequently the amount of waste is proportionately greater. In the United States, because of the expense in shipping as well as high labor and expensive equipment to wash, dry, and extract the oil, it is not practical as a commercial project. Italian factories are closer together and often the equipment used for expressing olive oil can be utilized for this purpose.

Pomace for oil recovery must be handled expediently so that the resulting products will not be spoiled. The skins are separated from the pomace either by floating in water or by drying the waste and then separating by blowing through a fanning mill. The dried seeds are then ground and the oil extracted either by pressure or by solvents. The solvent extraction will give a greater production yield per ton but the oil will not be of a high character.

An analysis of the pomace shows that it is high in oil and protein. The following are results obtained on the wet and dried pomace:

Analysis of tomato seeds and skin from pulp machine:

Wet Basis

Total solids	14.82	per cent
Moisture	85.18	per cent

Dry Basis

Ash	0.50	per cent
Fat	15.80	per cent
Starch	11.286	per cent
Sugar as invert	18.60	per cent
Total Nitrogen	0.63	per cent
Protein (N X 6.5)	4.095	per cent
Crude Fiber	30.25	per cent

An analysis of seeds by the U. S. Department of Agriculture on a 10% moisture basis showed a protein content of 23% and 20-25% fat or on a fat free basis from about 27.6 -28.75% protein.

As most of the pulping is done on the ground floor, it is necessary to elevate it to the kettles by means of pumps either steam driven or rotary. The pumps should be of bronze and not of iron on account of wearing qualities, as well as danger of iron contamination due to easy solubility and rusting while idle. The fewer times any product is handled, the better, for each handling means a loss in labor, material, and quality and the great danger of contamination.

METALLIC CONTAMINATION:—Zinc and copper are easily attacked and dissolved so that by the gradual accumulation of these metals, sufficient may be present in the finished product to impart a decided metallic taste. Copper salts [illegible] the red color of the tomato, turning it brown. When [illegible] parts per million, the red color of tomato [illegible] to a brownish red. Iron should never come in contact with [illegible] product if it can be avoided. The iron is [illegible] contact with tannin of the

soft that it is easily attacked and the kettles and pipes are soon pinholed. Nickel is sometimes a satisfactory metal, although expensive. If possible, brass pipe, and copper kettles should be tinned because tin will not impart a taste or discolor the product.

COOKING:—The cooking of tomato products is essentially an evaporative process and except for the heat necessary to sterilize the products, the less heat treatment the products receive during evaporation the better. Temperature and time each play a role. In buying equipment, the processor should seriously consider whether it can be used for other manufacturing purposes. It is poor management to buy equipment for a short season such as the tomato, when by judicial forethought, other equipment can be bought that will be used the year round.

In such apparatus as steam jacketed kettles or glass lined steel or cypress tanks equipped with coils, the effort is to evaporate with tremendous rapidity at atmospheric pressure which gives a temperature during the cook of about 212° F. Thus the effort here is to minimize the time required. The temperature required can be lowered in vacuum pans which are either copper or glass lined, although the time required remains about the same.

An erroneous opinion is often found among processors to the effect that evaporation in a vacuum pan at lowered temperatures requires less heat than at atmospheric pressure. Reference to steam tables will show that the latent heat of evaporation increases quite markedly at pressures below atmospheric. This means that more heat units must be supplied to evaporate a pound of water in a vacuum than would be required at atmospheric pressure. Therefore, if live steam is the heat source, the heat required for single effect vacuum evaporation will cost more than ordinary methods, to say nothing of the power required for supplying condenser water, operating vacuum pumps, etc. If exhaust steam is available in sufficient quantities, or if multiple effect evaporators are used the heat economy may be apparent.

In this book "Heat Transfer and Evaporation," Badger, 1926, says on Page 116, "Three is only one reason for employing a vacuum—to lower the boiling point, and this in turn is done for one of two reasons; to increase the available temperature drop, or to protect a substance sensitive to elevated temperatures (such as glue, fruit, juices, etc.)."

In tomato products manufacture, vacuum evaporation is used to protect color and flavor, principally in tomato paste manufacture, although it is used occasionally for other products.

Years of experience have shown that evaporation at atmospheric temperature for tomato products manufacture is satisfactory, except for paste making, provided that the apparatus is of proper design, installed properly, and, above all other things, if it is handled properly.

The choice of equipment will depend on the ideas of the owners which in turn will be influenced by first cost, space available, and adaptability to use with other products.

JACKETED KETTLES are usually made of copper for this line of work, although nickel and monel metal are also used. For pulp and catsup manufacture, they are usually of 250 or 500 gallon capacity. Kettles of this size should be purchased on specification, and not on price alone. This applies particularly to shape and to thickness of copper. A weak or light kettle is an abomination and indeed may be a serious hazard. One who is not familiar with what ought to be specified in purchasing a kettle should thoroughly inform himself before signing a contract.

Steam inlets on jacketed kettles are often too small. This results in slower evaporation than should be obtained. Cooks using this kind of apparatus are frequently demanding higher steam pressures to keep up production. For every pound of

water evaporated at least a pound of steam must be condensed. A little more than a pound of steam is required to make up for heat losses in other directions than evaporation only. If the steam is to be condensed in the jacket, it must first get into the jacket, and this requires passage from steam pipes through the inlets. The amount of steam that can get through an inlet hole is dependent on two things; first, the area of the inlet; second, the pressure that forces it through. If the hole is small, then the pressure must be raised to get more steam through it. Doubling the steam pressure will force approximately double the steam through the orifice, but doubling the area of the inlet will permit four times as much steam to pass through.

Pressures above 40 or 50 pounds are therefore adequate provided that the steam can get into the jacket. It is much more satisfactory and also safer to operate on lower pressures than on higher ones such as 90 to 100 pounds.

Drainage of the condensate must also be adequate and individual steam traps of a reliable type are recommended. Traps should be by-passed in case they fail to function properly.

The outlet of the kettle itself should be large, even larger than actually needed. For chili sauce a clear opening (inside diameter of 3 inches) is best. For any other product nothing less than 2½ inches should be specified. It is always easy to bush an opening down, but it cannot be enlarged without great expense. To bush down, an ordinary black iron bushing may be silver plated quite cheaply.

Small outlets delay production and decrease efficiency by keeping kettles out of operation while waiting for them to empty. Small steam inlets increase the time to cook a batch and consequently keep the product hot for a longer period than is desirable. Small kettle outlets increase the time required to empty and also keep the product hot for a longer period than is necessary.

Kettles may be lined with block tin or "washed" with tin. A tin wash will last but one season. Block tin is preferable and lasts many years. The heat conductivity of tin is less than that of copper and therefore a block tin-lined kettle will not boil quite as rapidly as a bare copper kettle.

COOKING TANKS may be either cypress or glass-lined steel equipped with copper coils through which steam passes. This equipment has become fairly well standardized, and its purchase is not attended with the need of specifications as is found with jacketed kettles. Glass lined steel equipment should be purchased with acid proof enamel specified.

Coils may or may not be tin washed or silver plated.

Tanks may be obtained in 500 to 1000 gallon capacities.

Outlets of the tank should be 2½ or 3 inches. Many tank outlets are much too small and delay production very seriously.

Steam inlets and outlets are standardized and though a manufacturer may have differing ideas the cost of special coils is usually too great to warrant the change.

Individual traps on each steam outlet should be installed, all discharging into a common header and this in turn going to the feed water apparatus. By-passes should be provided in case the trap fails to function.

Cook rooms, whether for tanks or kettles, should be as near to the boiler room as practical. Steam lines should be large, sloped in the direction of the flow, and drained properly. Valves to cooking apparatus should be always of the renewable disk type. Ground seat valves in such constant use as is found in this service will always be leaking just enough to scorch coils or kettles.

Outlets to tanks or kettles are best controlled by quick opening gate valves. Plugs on the end of wooden rods or chains are fairly serviceable but frequently work loose or the rods break causing serious trouble if the tank is full.

Making sauce, water from tomato juice is removed by these condensers after the seeds and skins have been strained out.

A most important provision for all cooking departments is suitable sewer connections and efficient means to flush all pipe lines with cold or hot water.

Cooking is principally evaporation or condensing the tomato juice to a definite concentration. There are two methods of handling cooking equipment which will be discussed again. One method is to place in the tank or kettle a definite volume of cyclone juice and cook it down to the proper concentration without the addition of any more juice. This method gives the shortest period of boiling of any but can hardly be carried out in kettles unless they have a very high collar about the jacket. It is more adaptable to tank cooking. If the liquid surface falls below the heating surface the product may burn.

A second method is to start cooking as soon as coils or jacket is covered and continue to add juice while the boiling is going vigorously until the apparatus is as full as practical. The concentration of the product is adjusted by more juice or more boiling until the desired end is found.

The first method makes for easier control and a slightly better product because it will not have been cooked as long. Twenty minutes will usually suffice. But on the other hand it does not utilize the full capacity of equipment and requires more units, if it is to be used at all times, than the second method.

The second method requires 25 to 45 minutes per batch depending on how large a batch is finished off and has the advantage of utilizing equipment to much greater capacity. A 1,000 gallon tank handled by the first method will finish at about 350 to 450 gallons depending on the concentration, while by the second method it will finish at 600 to 750 gallons.

If the first method is used with kettles, then it is usually necessary to combine two half cooked batches in a third kettle to complete the condensation or the jacket will be exposed and scorching will result.

KETTLE COOKING:—In cooking in open kettles a few precautions must be taken; the inside of the kettle must be perfectly clean before starting, and a small amount of any edible oil such as cotton seed or corn is often rubbed on the side of the kettle to prevent sticking. If possible this oil should be omitted as it may cause rancidity, but often green pulp will stick or foam up and boil over unless a small amount is used. Add enough pulp to cover the jacket and start cooking while the balance of the pulp is running in. The proper amount of pulp to be added may be controlled

by using a measuring tank placed about the kettle or by gauging the kettle accurately. The greater the steam pressure, the faster and better the cooking, with less loss due to burning, or sacrifice of color.

With the average kettle, cooking should not be started unless there is a steam pressure of at least 70 pounds while 100 to 110 pounds is preferable. This pressure, of course, is the pressure in the steam mains and is not as great in the jacket itself. To condense pulp in kettles it may be necessary to give it a partial concentration in one kettle and finish in the next one. It is seldom that kettles larger than 250 gallons are used, which means that only about one-half that volume, or 125 gallons, can be cooked at one time. When running pulp out of a kettle, it may be necessary to brush it from the sides to prevent sticking and burning, because it is almost impossible to obtain steam valves that will not leak. The time necessary to condense a batch of pulp should not be over 35 to 40 minutes to save flavor and color. Less time is preferable.

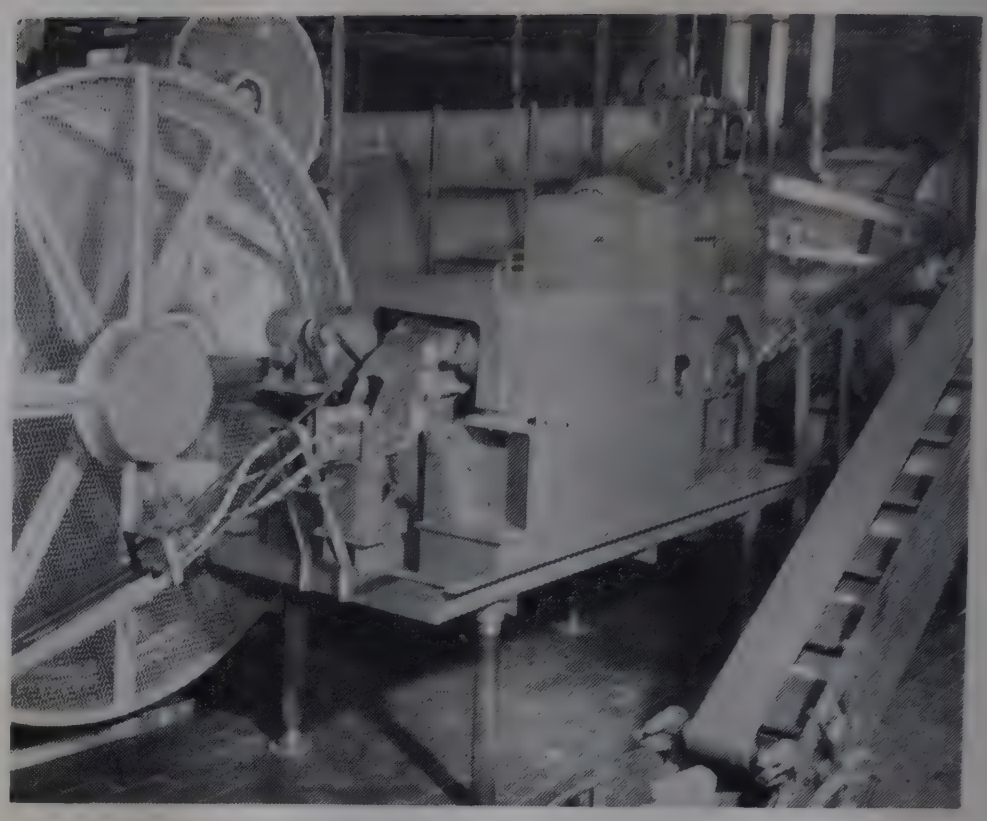
TANK COOKING:—All tanks should have concave bottoms to facilitate drainage. The tank must be mounted level and coils properly installed so that they drain perfectly. Water pockets in coils will certainly cause burning. Coils should be oiled with cotton seed oil before each cook to prevent sticking unless experience has shown this to be unnecessary.

Either the first or second method of cooking as described may be used although most plants use the second. In using coils, they should be covered with pulp before turning on the steam and the finished batch size should be such that it will also cover the coils when finished. Coils should also be connected with cold water to cool the finished product as this may prevent further cooking and sticking, but of course the water must be removed before starting to cook the next batch.

Due to slight defects, the coils may spring leaks and should be repaired temporarily by soldering until they can be removed and brazed. On account of low cost installation and great capacity along with durability and satisfactory results obtained, they are being used by a great many manufacturers. One of the chief objections to the wooden tank is the possibility of unsanitary conditions arising; mold, yeast, and bacteria will develop where the staves are joined if not kept perfectly clean. The tank and coils must be kept clean by frequent washing and boiling out with water. A strong stream of water may be sufficient to remove pulp, but coils should be examined from time to time to see that the pulp clinging to the underside is removed. If any sticks, it should be removed immediately with a wire scratch brush, stiff bristle brush, steel wool, pot scraper or copper chore ball. If not removed the burnt spot will increase in size, retard the cooking, and possibly give the pulp a burnt taste.

One may use tomatoes which have black scar tissue or pulp which has burned on the kettle or coils and later broken off or become dislodged and mixed with the pulp. These black specks can be removed by passing the pulp through a centrifuge. This method aids in the production of a superior product.

Glass-lined tanks are far superior to wooden from the sanitary standpoint. As the inside of the tank is perfectly smooth, it can be easily washed and kept clean. There are no cracks or crevices for the mold, yeast, and bacteria to become implanted and develop; it is always ready for use and does not have to be soaked or swelled as in the case of wooden tanks. [illegible] should be suspended or supported properly to prevent [illegible] or vibrating; otherwise, the enamel will [illegible] and leave an exposed iron surface. The walls of the glass-lined tank, being thinner than wooden ones, have [illegible] a greater heat radiation which can be minimized [illegible]



Automatic washer-dryer is used to wash filled cans before cooking or dry them after cooking, at rate of 300 per minute.

The bottom of the tank is concave and the coils are installed in much the same manner as in wooden tanks.

"BREAKING" the juice is an important operation with either kettles or tanks. The tomato fiber contains entrapped air that causes undue foaming when first heated. The process of getting rid of this foam is known as "breaking" the tank or kettle or "breaking the juice."

Some cooks use a paddle to break the foam. Others use a hose to shoot a stream of cold water into the foam. Another popular method is to throw a pint or half-pint of cooking oil into the foam. Occasionally even a combination of all three methods fails and the tank boils over. Compressed air blown on top of the foaming pulp may also be used.

In cooking by the second method, the losses due to boiling over are very small, as the tank is broken when it is only one quarter full.

After a batch is once broken, it should boil as rapidly as possible. If one can hold the hand over the boiling juice without getting burned by the steam the boil is too slow.

VACUUM PAN:—This method of cooking is being used more each year for cooking fruits and vegetables. There is no doubt that it does conserve the color and flavor of any product, but in order to obtain proper results in a vacuum pan, it is essential that the raw materials used be of good quality. One cannot take poor raw material, use a vacuum pan and expect to produce a fine product. Cooking under atmospheric pressure causes a certain change in the sugar present which does affect the color and flavor; this does not occur when a vacuum pan is used under average conditions. Cooking in open kettles, the temperature is anywhere from 212°-214° F., while cooking in vacuum, the temperature will range from 140°-152° F. depending upon the vacuum.

In order to use a vacuum pan efficiently the pulp should be heated to boiling either in kettles or tanks with coils before drawing into the pan. If the pan is equipped with coils they should be covered before starting to cook to avoid any trouble from sticking. Once the pan has started cooking properly, the rest of the pulp in the preheating kettle can be drawn in slowly and may be condensed almost as rapidly as taken in. Preheating can be done in the vacuum pan, but it is better to "break" the juice in kettles. More rapid evaporation will take place when the pulp is given a preheating than if taken in the pan cold. Preheating also breaks the foam so that the pulp will not be sucked out should it foam suddenly.

Vacuum pans of any size can be obtained and are either

glass lined, stainless steel, or copper. The initial expenditure is one great drawback. The glass-lined equipment is more sanitary and more easily cleaned than copper and will not impart a metallic taste to the product.

FINISHING POINT:—Before discussing this important feature it will be well to discuss some of the constants of the tomato itself and tomato pulp.

Both the tomato and strained tomatoes will vary slightly in their composition; this variation will affect the specific gravity and in turn will affect the results of the finished product as regards yield and quality. General climatic conditions—soil, fertilization, and location will cause a variation in the composition of the pulp; cool, wet weather will produce one poor in color and sugar, high in water, and low in specific gravity. Warm sunshine will produce a pulp of fine color, high in sugar, low in water, and high in specific gravity. Fertilization of the soil, variety of tomato, and location where grown will also produce similar variations of composition.

Composition of Whole, Fresh Tomatoes

	A	B	C	Edible Portion
Moisture	94.3	92.37	93.1	89.60
Solids	5.7	7.63	6.9	10.40
Protein	0.9	1.25	0.9	1.3
Fat	0.4	0.33	0.05	0.2
Fiber	...	0.84	0.8	1.3
Total Carbohydrates	3.9	....	....	8.1 (Inc. fiber)
Total sugars	...	....	3.5	....
Ash	0.5	0.64	0.7	0.8
Phosphates	...	0.081	...	....
Sulfates	...	0.081	...	....
Acid as Citric	...	0.29	0.5	....

Composition of Strained Tomatoes, i.e., Thin Pulp or Cyclone Juice

From N. C. A. Bulletin 21-L.

Total Solids	4.38
Insoluble	0.40
Ash	0.34
Sugar as Invert	2.27
Acid as Citric	0.29

One ton of tomatoes will yield about 200 gallons of pulp at a specific gravity of 1.020 or about 217 gallons of pulp specific gravity 1.019. The specific gravity of whole tomato pulp will vary greatly from as low as 1.0154 to as high as 1.028. In order to buy and sell pulp on an equitable basis some arbitrary scale must be used. This has been established at 1.035 and settlements are made on this basis, although recently 1.040 is being used as the basis. By specific gravity, we mean the comparison between the weight of a definite volume of pulp and the weight of the same volume of water, both taken at the same temperature, namely, 68° F.

In many plants it is customary to determine the specific gravity of the cyclone juice (or strained tomatoes) from previously prepared tables thus determining the proper finishing point. This, of course, involves cooking by gauge sticks. In other plants where the second method of cooking, previously referred to, is used the control is aimed at stopping the cook when the pulp has the right specific gravity regardless of the specific gravity of the original juice. This may involve some juggling with more juice and more cooking to hit the right mark.

Methods of Determining Specific Gravity

There are a number of methods of determining specific gravity of tomato products, each of which has ardent proponents. It may be determined by weighing cups or flasks, Pycnometer, Specific Gravity Hydrometers, Brix Hydrometer, Beaume Hydrometer, Westphal Balance, Refractometer, and the Strasburger method. The Hydrometers, the Westphal Balance and Refractometers work on the filtrate of the pulp and not on the whole product.

SPECIFIC GRAVITY HYDROMETER:—Special hydrometers standardized to read specific gravity at 68° F. can be made with any range or readings desired. They should be about 12 inches long in order to give as large readings on the stem as possible. For unconcentrated juice, it may be necessary to have the range from 1.015 to 1.030 and for concentrated pulp the range should be from 1.030 to 1.045 or higher if desired.

BRIX HYDROMETER:—This instrument should be standardized at 68° F. and range from 0-10° Brix graduated in tenths.

When either of these instruments is used, the pulp may be taken hot and strained through cheese cloth, cooled somewhat and the readings taken. This method is both rapid and accurate, but temperature corrections of the filtrate is taken and any necessary corrections, either as additions or subtractions, are made before interpolating the filtrate readings to those of whole pulp. The Specific Gravity and Brix Hydrometers do not give accurate results on whole pulp because it contains suspended fiber, air and foam that keeps the hydrometer suspended or prevented from moving freely.

WESTPHAL BALANCE can be used to obtain the specific gravity of the filtrate, making the necessary temperature corrections and interpolating the results of the specific gravity of the filtrate to that of the whole pulp.

COPPER FLASKS, WEIGHING BOTTLES, or volumetric flasks may also be used to determine the specific gravity of unfiltered pulp after the manner described by the laboratories of the National Canners Association.

BEAUME HYDROMETER:—This instrument is used by some manufacturers with very good results. It is graduated from zero to 50 degrees and readily replaceable in case of breakage. Once standards have been established, this method is very rapid and accurate.

Each manufacturer will have to make his own standards for this instrument (which he can set up quite easily) because there is often a difference in the mesh of wire screen of finishers used. This instrument can also be used on unfiltered thin cold pulp. A sample of the hot pulp is taken in any suitable vessel and the hydrometer reading taken; screen the sample through the finisher having previously run through several gallons of the same pulp in order to clean it out and remove any danger of dilution. When the sample is cold, determine accurately the specific gravity. It may be necessary to make tests of various samples taken at different stages of the concentration and determine accurately the specific gravity. This determination will show the relationship between the Beaume reading of the hot pulp and the actual specific gravity of the cold pulp. Once this relationship is established, the same finishing point may be used in all determinations. This instrument can be furnished by instrument makers.

THE STRASBURGER method is a quick method that can be used to determine the specific gravity of pulp. It is both rapid and accurate.

By mixing certain non-aqueous liquids of different specific gravity such as carbon tetrachloride and mineral oil, solutions of any desired specific gravity can be obtained. As these mixtures are not miscible with watery solutions, they will either allow the watery solution to sink in droplets to the bottom, float on the surface, or become suspended in the liquid. By mixing carbon tetrachloride which has a very high specific gravity (1.5835) with mineral oil which is low in specific gravity (0.7782) solutions can be obtained which have great ranges of specific gravity. Kerosene oil is often substituted for the mineral oil in making the blend. However, on

account of its volatility the solution or blend is likely to change its specific gravity.

In testing, remove a sample of pulp, draw a portion into a thin glass tube, hold it under the cold water for a few seconds to cool and then add a few drops of pulp to the test solution of the right gravity contained in vials or test tubes. If the pulp floats on the surface, it is too thick; if it sinks, the pulp is too heavy, but if it is of the right specific gravity, it will be suspended in the test solution. Quantities of the test solution should be made up and standardized occasionally as the specific gravity of the solution will often vary due to evaporation of the carbon tetrachloride. It is well to have several solutions of lower specific gravity made up, and as the end point approaches keep trying the pulp in the various ones until it has the right density. The test solution can be reclaimed by settling, pouring off any liquid on the surface and straining through cheese cloth, flannel, and finally paper; but this solution must be standardized before using. If the solution should extract too much color from the pulp, it should then be discarded. This method is seldom used today because other rapid and more accurate ones have been developed.

SPECIFIC GRAVITY BY WEIGHT:—This method involves the actual weighing of the pulp either in copper flasks, standardized flasks, or pycnometers. The method is to first weigh the empty container, then fill with boiling water and weigh and the difference is the weight of the water used; then fill the container with the hot pulp, weigh, and subtract the weight of the empty flask, and the difference equals the weight of the hot pulp. To obtain the specific gravity divide the weight of the hot water into the weight of the hot pulp, and the result equals the specific gravity of the pulp.

The specific gravity can also be determined on cold liquids in the same manner, but cold water and cold pulp should be compared. Hot and cold liquids should never be compared. This method is not considered quite as accurate as some of the other methods in handling the tests of hot pulp because the liquids cool rapidly, shrink, and may also contain air and foam. Delay in making a test will, therefore, affect the result. When properly made on cold pulp, it is the most accurate method we have.

REFRACTOMETER METHOD:—The refractometer is a quick and fairly accurate method of obtaining readings of specific gravity.

The Abbe Refractometer, the Immersion Refractometer or the Bulfrich Refractometer may be used. There is also a special modification of the Abbe Refractometer graduated to read the specific gravity directly. The latter is applicable to pulp only, and furthermore, only to pulp from tomatoes in that part of the country on which the instrument was originally calibrated.

Temperature °F.	Temperature °C.	Abbe Refractometer Reading	Immersion Refractometer Reading
68	20	1.3330	14.5
71.5	22	1.3328	14.0
75.0	24	1.3326	13.5
79.0	26	1.3324	13.0

SUMMARY OF METHODS:—Control and analysis should be distinguished from each other. Control is the rapid analysis or approximation of the true analysis carried out by the cook or his helper on the cook deck. Good control of specific gravity requires great speed of testing and a method re- 5 to 10 minutes to make a test is of little value for it may be excellent for analysis, for the the cooking is stopped while testing, the tank or kettle will be very much more con- than the sample being tested.

accurate but are for the analytical laboratory when checking over the season's production rather than for controlling cooking. The refractometer has replaced all other methods for speed, accuracy and ease of operation. It can easily be used by factory help with excellent results. The prepared table can be framed and placed near the point of operation for reference.

In cooking pulp, it is usually necessary to determine the specific gravity of the raw plain juice and that of the finished product. If the specific gravity of the plain juice is determined, the end point can be easily found by using a gauge stick. For convenience in measuring, it is well to have all tanks gauged accurately. This can be done either by calculating the capacity from measurements of the cookers, or else by using a water meter. If the sides and bottom of the tank are straight, calculations can be easily made, but where the bottom is concave and the tanks contain coils, this is a little more difficult. In using a meter, run in any amount of water either judging by inches or else by gallons, say twenty gallons, then heat the water to boiling point and measure the distance on the gauge stick, mark it accurately and continue to gauge for other capacities. The volume of the finished pulp is measured hot and hence, the gauge should be made on a hot solution. If the gauge were made using cold water, then when the pulp cools, the volume would be less than the volume measured and the yields not accurate.

This method of concentrating to a certain finished volume, knowing the specific gravity of the thin pulp, i.e., strained tomatoes, and using a measured amount to start with, gives very good results. This is the first method of cooking described above. Some cooks can tell by appearance, without testing, when the pulp is finished but they are indeed rare. In these times of standardization, it is far better to depend upon more accurate methods of determining the finished point. If either the specific gravity or Brix hydrometer is used, the end point can be judged with a gauge stick from the amount of concentration when a definite volume of pulp of a certain specific gravity has been used without making any specific gravity tests on the finished product.

ADDITION OF SALT:—If salt must be added to pulp, it should be added just before finishing. The salting of pulp is a subterfuge to make it taste a little better or to increase the specific gravity. Do not cook the salt in the pulp any length of time because it will affect the color, attack the copper kettle and produce a metallic taste.

Consider the buyer—the big buyer of pulp. What does he buy it for? He buys it to put into some kind of sauce, usually bean, spaghetti sauce or soup. The pulp is only one ingredient of a carefully worked out formula which calls for a certain amount of salt. If perchance, he inadvertently uses a salted pulp, the sauce will be too salty and may cause a great loss as well as no end of trouble. Hence pulp contracts usually specify that no salt or sugar may be added.

FINISHING:—The pulp may be run through a final finisher in order to be smooth and free from any possible coarse particles, seeds, skins (not taken out by the first finisher) or other extraneous material that may have fallen into the batch; this assures cleanliness, smoothness and uniformity, especially if any pulp clings to the kettle or cooker and is thick when it finally runs out. Care should be taken so that nothing falls into the finished batch and if the pulp has to stand any length of time it should be heated again before running it out.

FINISHERS:—There are a number of excellent finishers, which produce clean pulp. Some are single and again they may be connected in tandem, but if efficient cycloning has been done before the pulp is concentrated, one should be sufficient. It hardly seems necessary to pass the pulp through a finisher but a great deal of coarse fibrous material is

moved. The mesh of the screen used is often 0.027 inch holes or a screen with 0.033 inch holes. These divide the pulp into very fine particles and, naturally keep it well suspended with a minimum of separation.

When there is a shut down between batches, the operator of the finishing machine should take it apart and wash all of its parts thoroughly and then use steam, in order to sterilize. Cold pulp and waste material accumulating in and about the finisher will contaminate the next batch. Watch the set of brushes to obtain the best results so that a smooth pulp will result. A great many screens used in finishers were formerly made of brass, but due to the corrosive action of the fruit acid and the metallic flavor imparted to the finished product, nickel screens are being substituted. Brass screens were silver plated, or tinned, but the constant rubbing of the brushes in conjunction with the action of the fruit acid soon removed this coating. When standing between batches without being washed the metallic flavor of the pulp clinging to the screen is quite pronounced. As an extra safeguard, a spare screen should be provided for emergency.

FILLING PULP:—Automatic fillers can be obtained for filling cans up to No. 10's but 5-gallon cans are usually filled by hand with a hose, one at a time or by using pipe either connected singly or else in the form of a manifold to fill any number at a time. Too many should not be filled at once, because the operator cannot see how full they are and may encounter considerable overflow loss. Fill the cans to the top and wipe off the excess with a clean cloth or sponge kept in hot water, but do not attempt to add any cool or cold pulp in case the can is not filled because this cool pulp may cause fermentation. A simple unit to fill any number of cans can be made by making a box out of heavy cypress and dividing it into compartments, each holding exactly five gallons. A two or three compartment filler will keep the operator busy. The pulp is run into the reservoir until all compartments are full, then emptied into cans. The chief objection to this filler is that it is made of wood and therefore may be unsanitary.

Because of economy in space occupied, and ease in handling, the square cans are used more than the round ones. All 5-gallon cans whether new or old should be tested for leaks. Can testers that are easily operated by women can be bought or easily made. The saving of a single 5-gallon can of pulp will pay for the testing of many empty ones. With fair usage they can be refilled with pulp two or three seasons. Old cans should be carefully inspected for pin holes, bad seams, rusting and cleanliness. If the holes are small and very few they can be soldered and retested, but if the can is rusty on the inside, it should not be used. Any old pulp clinging to the can—both inside and out—should be removed; if this is not done the mold and yeast spores may remain dormant until the can is filled with fresh pulp and spoilage may occur. Most factories give no special attention to the storage of either empty or full cans, as to whether they are in a dry clean storage, or in a damp cellar. Sort carefully any cans that have been used before and if there is any rust, or doubt about them, reject them rather than take a chance. Wash all cans, new and old with a well directed stream of water in the form of a spray so that all parts of the can will be reached; then steam for about one minute in order not only to heat but to sterilize. Never allow the cans to cool before filling.

It is very important that they be capped and tipped properly. Poor capping will cause spoilage. The person hauling the pulp away should inspect for leakers. After capping, the cans may be turned over on their sides in order to sterilize the cap end. The filled cans that are hot should be handled carefully because the great weight and heat may cause a strain and the rough handling may break a seam; this is especially true of used cans. The more they are handled and the rougher, the greater the danger of spoilage.

It is advisable to separate and stack separately each batch or each day's run. The batches should be given lot numbers which can be stenciled or stamped on the cans in order to identify them should occasion arise. It is almost impossible for each batch or the day's run to test the same as to quality —although they all may have practically the same specific gravity or concentration. Each factory has its own system of keeping record or markings of the cans. When the tomatoes are running poor in color or are bad, it is well to keep these runs separate.

STERILIZING OR PASTEURIZING:—Pulp at 190° F. in No. 10 or 5-gallon cans properly sealed will have enough heat to sterilize itself. Anything filled at a temperature below 180° must be processed in some way. To process 5-gallon cans is too cumbersome. It is better to open and reheat. No. 10 cans filled below 180° F. should receive 1 hour in boiling water and then be cooled.

No. 1 cans should always be processed regardless of the temperature of fill as they will cool off too quickly to sterilize themselves.

STORING OR STACKING:—All pulp should be stacked in a cool, dry warehouse preferably off the floor. Air space should be left between the cans to allow air to circulate and thus cool, otherwise, the pulp may have a cooked taste, turn brown or even black. It pays to take precautions in stacking the pulp properly for the sake of the saving of cans alone each year. If not given the proper ventilation, often a pile of cans will remain hot for about 10 days.

Pulp cans are made either with 107-pound or else 135-pound plate, either plain or lacquered. Inside enamel protects the life of the cans. Some packers use plain cans and lacquer the outside only to prevent rusting. In enamelled cans there are usually a few small spots where the coating does not cover, and thus the action of the fruit acid may be more intense at this one spot and may cause pinholing quicker.

In stacking, too great a load should not be placed upon the cans. They should not be stacked over 4 or 5 high for 107-pound plate, and 8 high for 135-pound plate; if higher too great a strain on the ones underneath may cause the seams to spread and the cans may collapse. The higher the pile, the harder they are to handle and the rougher treatment they will receive.

BARREL STORAGE:—There is very little pulp packed in barrels today, as it has been found that this method is extremely unsatisfactory. Pulp put away in barrels will lose color and flavor and most likely will mold and ferment. Good clean uncharred barrels, steamed about 5 to 7 minutes are used; the pulp is filled boiling hot and the bung covered with clean cheese-cloth or burlap before driving in. Roll the barrels to a cool place where they are to remain undisturbed until ready for use. On account of the great volume, the heat is retained for considerable time and on cooling a vacuum or suction is formed which may draw air (laden with microscopical organisms) into the pulp through the pores of the wood. The organism or spore may start development whenever the temperature is ideal for their existence and propagation. Painting the barrel will to a large measure prevent some of this spoilage but is expensive. The hot pulp will leach some of the tannin from the barrel; iron salts in the pulp and the oxygen in the air in the barrel may cause darkening which will intensify after being finished.

Tomato Paste

SOAKING, WASHING AND SORTING:—The same general method of handling tomatoes and obtaining the tomato pulp is applicable to tomato paste manufacture. Great stress must be placed upon the sanitary feature of handling the raw material to remove decayed stock and to see that they are thoroughly washed to remove sand. As paste is a pulp con-

centrated often as high as 6 or 7 to 1 naturally the sand present is also concentrated in the same proportion. It is rather unpleasant to eat any product containing sand.

DETECTION OF SAND:—Sand is easily detected either by placing some of the paste on the molars and grinding. If present it is easily detected, or it can also be detected by mixing the paste with a large volume of water, shaking, and allowing it to stand a short time, decant the tomato water, shake again with a large volume of water and again decant. Continue this method until the water is quite free from tomato solids and the sand will be found in the bottom of the vessel. Tomatoes, especially those grown in New Jersey, Maryland, and Delaware near the sea shore, contain what is called wind blown sand; the very fine particles of sand being blown against the tomato will often be microscopical in size and penetrate the tomato, especially where the skin has been broken and healed over.

Quality tomatoes should be used to obtain a good colored and flavored paste. Do not use poor tomatoes and expect to obtain a good paste.

Two cyclones or one cyclone and one finisher should be used to assure a fine smooth product, to remove green and coarse fiber, seeds, skins, and black scar tissue. One cycloning makes a coarse paste, while running through two machines will produce a smooth product with a fine color and good tomato flavor.

Each firm has its own idea regarding the handling of the tomatoes. Some run the tomatoes directly from the washer into a 4-inch centrifugal pump, which tears them into very small pieces and delivers them to the cooking kettle. There they are slowly heated to the boiling point, which requires about ten minutes to separate the coarse pieces from the clear juice. This juice is drawn off and condensed separately while the coarse pieces are run through a finishing machine to remove seeds and skins. This concentrated juice can then be mixed with the thick pulp or utilized in other products, such as soup or bean sauce. This clear separated juice is often discarded without trying to utilize it in any product, while the concentrated fibrous pulp is canned. The clear liquor contains the greater part of the sugar, acid, flavor, and mineral substances of the tomato, while the coarse pulp contains color, small amount of flavor, acid, and mineral matter. The separated juice which is often discarded can be filtered to remove any particles of pulp and produce a brilliant and clear product. Heat to at least 140° F., fill into cans or bottles, cap and sterilize the same as sweet cider or grape juice.

The flavor of a paste made from coarse fiber cannot compare in flavor with paste made from the whole tomato. Paste made from fiber only appears thicker yet may contain only one-half the solids of whole paste and is milder in flavor. The color is often better because the color in the tomato lies in the fiber and the watery liquid drawn off is of a pale straw color.

This preparation method also can be applied to tomato pulp. Heat the pulp slowly to boiling and allow it to stand for a short time in order to separate. Draw off the liquid and condense it for use either in soups or to be mixed with the concentrated fiber. It has been used as an emergency method when boiler capacity was short and of course the clear juice was discarded.

COOKING:—Paste is either made in copper kettles or vacuum pans. Tanks with coils are seldom used because of the comparatively small cooking surface and ease with which a heavy product will stick or burn on the coils, thus taking much longer to finish. When paste is made from the separated pulp after the juice has been drained, it can be cooked direct in open steam jacketed kettles. The more rapid the concentration, the better the color and flavor. As tomatoes contain about 5% solids and 0.4% acidity, paste made from a good product of from 10-17% and an acidity of about 1.2%; this is a concentration of about 3 to 1.

OPEN KETTLE COOKING:—In using open kettles, it may be found expedient to coat the inside of the clean kettle with a little edible oil by means of a swab or broom to prevent sticking or burning. Add enough pulp to half cover the jacket before turning on the steam and when the pulp boils briskly and the foam has been broken, more pulp can be added slowly in order not to stop the boiling. Should the pulp foam too violently, a small quantity of any edible oil may be added or a very fine stream of water under pressure will break it. It may be necessary to shut off the steam and allow the foam to settle before starting again. Very little oil should be used, as it may cause rancidity and produce an off flavor. The proper amount of pulp to be added may be controlled by having measuring tanks over the kettle or by gauging the kettle for the amount of pulp that has been found to be advantageous to cook.

The kettles should be trapped to take care of the condensed steam and connected with a by-pass, so that if the trap does not work properly the condensate can be removed by blowing into the air. In starting to cook, as well as at the finish, it is well to open the by-pass to remove air and water. Traps should be taken apart and all scale removed so that they will work smoothly. If the trap is not working properly, the pulp will stick to the kettle and burn. Steam of 80 to 100 pounds permitting rapid condensation will help to prevent sticking.

When running the finished paste from the kettle, it should be brushed down the sides to prevent sticking and burning. It is rather difficult to make paste of high concentration in open kettles without this trouble. It may be concentrated about 2.5 or 3 to 1 in the first kettle and then transferred to another one to be finished.

The color and flavor of open kettle paste are usually not as good as that made under vacuum. The color and flavor of pulp or paste is not affected until after the concentration is about 1.04 specific gravity (or about 2 to 1). The higher the temperature and the longer the time required in cooking, as well as concentration, influences both color and flavor.

VACUUM KETTLES:—Vacuum pans are either copper or glass lined. On account of the action of the acid on the bare copper, especially in a highly concentrated paste, a coppery taste may be imparted, particularly if salt is added. Each pan has its own idiosyncrasies, and the operator knows them only too well, so a discussion on operating the pans is omitted. Some use a single unit pan, others use triple, and quadruple effect, where the exhaust steam from the first pan operates the second, third, etc. The principal objection to this system is that if one pan in the battery is out of commission, none of the others can be used. Horizontal heating tubes are often placed in the pan to aid in rapid evaporation because they offer a greater heating surface.

In making paste in vacuum pans, the pulp is given a preliminary heating in an open tank or kettle. This heats the product and allows more rapid condensation. It also breaks the foam and prevents the pulp from being sucked out of the pan and makes it far easier to handle. Condensation can take place while hot pulp is being drawn into the pan; the rate of condensation may be so timed that the evaporation is taking place as rapidly as the material is being drawn in. If the pan contains coils, these should be covered before starting the evaporation and the finished batches should be large enough to keep them covered. Boiling takes place at from 120-140° F. and because this temperature is not high enough to destroy the bacteria, yeasts, and mold spores, the temperature of the finished product is increased to at least 190° F. before filling. This can be done either in the pan after releasing the vacuum or else in the storage tank after emptying the pan.

NEUTRALIZING:—Tomato paste made from the pulp of tomatoes grown in the East will have too high an acidity and be too sour for consumption. Italian and California paste (lower in acidity) is milder and has a better tomato flavor. As thin pulp, or strained tomatoes, has an average acidity of 0.45, an increase of concentration of 5 to 1 or even greater will produce a paste with an acidity of 2.5-3%. There are, however, two methods whereby paste from Eastern tomatoes can be made milder: one is to separate and discard the juice separated from the pulp by gravity and the other method is to neutralize the excess acidity with caustic soda, sodium carbonate, or sodium bicarbonate or other neutralizing substance.

CAUSTIC SODA:—Sodium hydroxide, also called caustic soda, or lye, has not given as satisfactory results as the other two, as it may produce a peculiar odor and taste and affects the color of the finished product. As caustic soda may contain iron and manganese, it may be impossible to obtain it in a relatively pure product unless "Chemically Pure" (C. P.) Caustic Soda is used. Iron and manganese produce an off taste, and influence color. On account of the expense and great danger in handling this substance, the other neutralizing agents are more commonly used. In using caustic soda, 3 quarts of a 40% soda were used to partly neutralize the acidity of 400 gallons of pulp to be used in making a paste of 25 per cent solids.

Sodium carbonate or soda ash, Sal soda, or Bicarbonate is cheaper than sodium bicarbonate (baking soda) and only about 63% as much is required as is of baking soda. There is no question but that the color and flavor of paste is greatly improved by neutralizing some of the excess acidity. With a little care it can be successfuly used. The following table has been prepared for using either sodium carbonate or bicarbonate, in whole pulp so that one-half of the acidity present is neutralized.

Bicarbonate of Soda

Per cent acidity pulp as citric	100 gallons pulp Ounces soda	60 gallons pulp Ounces soda	50 gallons pulp Ounces soda
0.1	8.0	4.8	4
0.2	16.0	9.5	8
0.3	24.0	14.4	12
0.35	29.33	17.6	14.66
0.40	32.5	19.2	16.25
0.45	36.5	22.0	18
0.50	40.75	24.5	20
0.55	44.75	25.8	22.66
0.60	49.00	29.4	24

Sodium Carbonate

Per cent acidity pulp as citric	100 gallons pulp Ounces	60 gallons pulp Ounces	50 gallons pulp Ounces
0.1	5.0	3	2.5
0.2	10.0	6	5.0
0.3	15.0	9	7.5
0.35	18.4	11	9.2
0.40	20.5	12.3	10.25
0.45	23.2	13.9	11.6
0.50	25.5	15.4	12.35
0.55	28.2	16.9	14.1
0.60	30.9	18.5	15.4

The addition of either kind of soda causes great foaming, spattering, boiling, and loss unless handled properly. Do not add the dry soda to the pulp because the sudden liberating of gas will cause the pulp to foam up suddenly and perhaps over flow. Mix the soda with a small amount of water and gradually add this in the kettle while the pulp is cooking. Only use about one-third to one-half of the pulp while neutralizing in order to give cooking space in the kettle. It is harder to handle the soda ash than the baking soda; however, if a small amount of vegetable oil is mixed with the soda and water before adding it to the pulp, it can be added without any trouble. The pulp should be neutralized in open kettles rather than in vacuum pans on account of the great foaming. In order to keep the acidity uniform in the finished paste, the pulp should be handled in two tanks or reservoirs, located above the cooking kettles so that one tank can be tested and the proper amount of soda calculated for the batch while the other tank is being filled and tested.

SALT:—The addition of a small amount of salt to tomato paste may be used, as some think it improves the flavor. To a certain extent it will mask any slightly off taste due to scorching. Salt is added at the rate of about 1 per cent or 1/25 ounces per gallon of finished paste. Dissolve the salt in a small amount of water and draw it into the pan when the paste is about finished because when it is added sooner, there seems to be a chemical action which takes place causing liberation of corrosive vapors or gases that produce verdigris on the inside of the pan. This occurs only, however, when a bare copper vacuum system is used.

BASIL:—Some paste is packed with basil, each can having a basil leaf placed in the bottom before filling. As basil leaves are expensive, the oil of sweet basil is often substituted. Since the oil is very powerful, it must be used discretely, otherwise the paste will be spoiled because the basil flavor on standing seems to intensify and penetrate the entire product. In using the oil of basil it is advisable to "cut" or dilute it with any vegetable oil that does not easily turn rancid quickly, such as corn or soya. The stronger this blend is made the greater the danger of adding an excessive amount unless the operator is extremely careful in measuring the quantity added. A one per cent blend can be used, or if the amount to be added to each batch is large, a ten per cent blend can be substituted. The oil of basil should not be cooked during evaporation of the batch, but should be added when the end point has been reached. If the pan has a stirrer the oil may be added while the stirrer is running and mixed for not less than 5 minutes; or, the oil may be added and either mixed by hand with a paddle, or when the pan is being emptied. The pumping will aid in mixing when run into the supply reservoir where it should be thoroughly mixed again before filling into cans.

Use six ounces of a one per cent oil solution for 70 gallons of finished paste. Paste containing the basil is so labeled as it has very desirable flavor for a certain class of consumers.

COLOR IN PASTE:—If the tomatoes have a poor color, the paste made from such stock will also be poor in color, and in order to produce a brilliant product, artificial color is sometimes added. Some states have ruled against the use of any added red color to tomato paste or to tomato products because it masks or hides damage or inferiority. Coal tar colors, such as Ponceau, Amaranth, etc., give wonderful results when blended properly but unfortunately coal tar colors cannot be used in paste that is packed in plain cans. There seems to be a reaction between the tin, tomato acid and the coal tar color that causes the color to change from a beautiful tomato red, first to a pink, and then to a reddish chocolate brown. If the product is to be packed in glass, then the coal tar dye is effective. In using coal tar colors, dissolve one ounce of dry color in a quart of water and blend the separate colors by mixing together thoroughly. A good blend is made by mixing together solutions of the following certified food colors:

Ponceau Liquid.....	60 c.c. or 60 ounces
Amaranth Liquid.....	15 c.c. or 15 ounces
Guinea Green Liquid.....	1 c.c. or 1 ounce

Add 88 ounces of this blend to 70 gallons of finished paste. Do not cook any longer than is necessary.

Extract of cochineal will not give the same results and is too expensive.

Carmine seems to give the best results when used with tomato paste. It has tinctorial strength, will not bleach, and does not impart a flavor to the product.

SOLUTION OF CARMINE:—To one pound powdered carmine No. 40 Dark, add 32 ounces of 28 degree ammonia and one gallon of water. Heat in a well ventilated place until all of the carmine is dissolved, then add water to make two gallons of solution. Care must be observed in handling the ammonia because of its powerful fumes and the action it has on the eyes, skin, and lungs. Boil the carmine solution slowly to drive off the ammonia fumes and add about 10-15% of glycerine as a preservative. Some will not remove all of the ammonia, but add the glycerine and use. Since the carmine solution is used in a product that is excessively acid, the small amount of ammonia added will not affect the flavor or odor, but will aid in neutralizing excessive acidity.

Carmine solution like basil should not be added during the cooking, but to the finished paste either in the pan or else in a mixing tank, after which it should be thoroughly mixed before filling into cans.

Use 48 ounces of carmine solution of the above strength to 70 gallons of finished paste. This quantity may be varied depending upon the color of the tomatoes used.

The tomatoes at the beginning and end of the season usually have a poor color, and should a manufacturer want to keep his product uniform in color by the addition of a harmless color, it must be declared on the label, or the product will be considered adulterated. The cans are often labeled "with approved color" or "approved color added," or "artificially colored."

THICKENERS:—The addition of any substance that tends to thicken the product is considered an adulteration. Starch (usually corn) has been used, also potatoes after being peeled and grated or ground are known to have been added because they have fiber and starch.

AGAR:—Agar with its great thickening properties has been also used for this purpose.

PECTIN:—Since the advent of pectin in its pure state either powdered or liquid, it now is being used to a certain extent in tomato products in small amounts of about 0.1-0.2%.

FINISHING POINTS:—It is necessary to have a rapid method for determining when the paste has been concentrated to the proper consistency. There are several good methods that can be applied quickly to a product sample while concentration is still going on. If the product is not properly condensed, the product will be light in specific gravity, and not be up to standard, while if condensed too much the manufacturer will lose greatly as one or two points in the specific gravity will mean a loss in paste yield. The manufacturer prefers to keep his products standard and uniform all the time.

There are several tests that can be applied to detremine the finishing point. A simple little instrument called the "Collo-Clastometer" can be applied to a small sample. It consists of a very small cylindrical weight attached to a small piece of wire, both suspended by a thread. Cool the sample quickly, then slowly lower the attached weight to a smooth flat surface of the paste. If the paste is too thin, the weight will penetrate the surface and sink lower, whereas if it is of the proper consistency, the weight will rest on the surface and both weight and wire have a tendency to turn on the side and should not lift any paste as it is raised from the surface. The following are the weights for paste of different solid contents:

[illegible] solid—weight used 0.456 grams, weight of [illegible] grams; total weights 0.673 grams.

[illegible] solid—weight 0.622 grams; wire 0.315 grams; [illegible] grams.

[illegible] grams; wire [illegible] grams;

total weight 0.963 grams.

A few other simple tests can be applied to a sample of whole tomato paste containing about 25% solids. As a sample is warm when removed from the vacuum pan, it should be cooled by stirring. When cooled a teaspoonful of the paste will cling to the spoon and not slide off when the spoon is turned on its side. Also when a sample comes from the vacuum pan, it will stand up and keep the original shape of the drop and not spread or run. When a spoonful of the paste is turned over in a dish, it will also have a shining surface. A very small hydrometer (urine hydrometer) about 4 inches in length can be used in testing the specific gravity of the filtrate from pastes containing about 15% solids. A sample is squeezed through a cloth and the specific gravity is determined on the filtrate. It is necessary to know the specific gravity of the filtrate of the standard selected and use it as the basis for all determination. The filtrate will test 1.055 and show 1.062 on the whole paste with solid content of 15%.

The paste can be diluted with an equal quantity of cold water then filtered and the specific gravity of the filtrate determined. While this method is not accurate, yet the manufacturer can use it as a comparative test for his product. One ounce of paste by volume weighs more than one ounce of water so that by taking equal volumes of paste and water, the test can only be considered comparative. If he has determined accurately the solids or specific gravity of his product and then makes a test by this method he can use the result as his standard for rapid checking by this method.

An Abbé refractometer can be used in rapid determinations of the solids by taking a reading of the filtrate and calculating the actual per cent present by using tables. If salt has been used in the paste, then the refractometer reading is incorrect unless the percentage of salt is determined and corrections made for its addition.

Cool a sample of the paste in a corked flask or bottle as rapidly as possible in running water or ice water. Shake thoroughly to insure uniformity. Filter through a fluted filter paper, rejecting the first few drops coming through. Place a drop of the filtrate on the prisms of the Abbé refractometer equipped with a water cooler and take a reading.

FILLING:—Paste cooked in vacuum seldom exceeds a temperature of 152° F. Consequently it is not very warm and should be heated before filling into cans. This may be done in the vacuum pan by breaking the vacuum and turning on the steam until the desired temperature is obtained or else the product can be run into open jacketed kettles and then heated to the proper temperature, which should be not less than 190° F.

After filling and capping, the cans should not be permitted to stand around to cool off, nor should partially filled process baskets of paste be allowed to wait for the next batch; especially if there is any interim between batches. Processing should follow immediately. Paste that is low in acidity will ferment or sour in a very short time, so that great care should be taken to keep all lines from the vacuum kettles to the fillers clean and sweet. Paste should not be permitted to stand in the fillers for any length of time while not operating or during a lengthy shutdown.

STERILIZING:—If the paste is processed in a continuous sterilizer where the cans roll continuously the time can be decreased materially. Paste being very heavy, the heat penetration is extremely slow.

Processing in vertical retorts the following time and temperature is used:

4 to 6 ounce cans processed 45 minutes at 212° F.
No. 2 cans processed 85 minutes at 212° F.
No. 3 cans processed 85 minutes at 212° F.
No. 10 cans processed 90 minutes at 212° F.

Where the cans are processed in an agitator cooker 5 and 6 ounce cans are given 18 minutes at 212° F.

After processing the cans are cooled to prevent stack burn.

Tomato Catsup

"Tomato catsup is the concentrated product made from the pulp and juice of ripe tomatoes (exclusive of skins, seeds, and cores), a vinegar, salt, spice and other seasoning, sugar and/or dextrose."

Most catsups are made by concentrating thin pulp of about 4.5-5% total solids from 120 gallons to 55 gallons finished catsup, or a concentration of about 2.18 to 1. Some of the catsups low in solids have a better tomato flavor because the other ingredients are reduced in proportion to the solids and consequently are not so highly seasoned.

The consistency of commercial catsup often varies from a thin fluid to the other extreme, i.e., one that will scarcely pour from the bottle. The average of non-preservative catsups will contain about 25-27% total solids. Catsup of about 25% solids usually has a better tomato flavor than one with higher solids, as a higher solid content usually means the addition of more sugar and vinegar, which masks the tomato flavor. Of course the increased sugar as well as vinegar aids greaty in preservation. The tendency today is to increase the total solids to 32-35%.

The analysis of tomato catsup show a great variation in the solids, salt, vinegar and sugar of commercial catsups.

The general method of handling, shipping, sorting, washing and pulping has been discussed in details in the section on tomato pulp, and is also applicable to pulp for catsup. However, the two methods of hot and cold pulping are worthy of discussion again. Tomatoes are often cooked in a breaker tank before pulping while others prefer the cold pulp method. Each method has its special advantages and disadvantages.

HOT PULPING will produce a greater yield and will also aid in extracting the vegetable gums that seem to be around the seed, and extracting any pectin present. It will, however, introduce a greater amount of green and unripe tomato fiber and tannin which affect the color adversely. Water will also be introduced from condensed steam in the lines which must be cooked out later, in addition to iron in the form of rust or scale from the steam lines.

COLD PULPING will remove more of the green fiber and therefore produces a better color and flavor; it will not introduce an excess of water or any iron. Two pulping machines in series give better results; the first removes the skin, seeds and coarse fiber while the second will remove the finer green and unripe particles. One advantage of the cold pulp method is that a great surplus of pulp is never on hand in case of a breakdown in machinery as the pulp usually is being cooked as fast as it is being produced. Pulp ferments or sours and molds quite rapidly.

WHOLE TOMATOES:—One manufacturer cooks the tomatoes with the spice, sugar, etc. and then passes the batch through finishers to remove the seeds, skins, etc. He is of the opinion that he produces a superior colored and flavored catsup. The color is "set" and more intensified and all the pectin extracted which produces a thick catsup. There is a loss of some sugar in the seeds and skins by this method but it is thought that the improved quality is worth the slight loss.

Analysis of Different Brands of Catsup

	Total Solids	Total Acidity (Acetic)	Ash	Salt	Total Sugar
1	25.73	1.20	3.66	3.05	14.78
2	22.10	1.26	3.31	3.42	12.16
3	31.90	1.70	3.76	2.88	20.44
4	28.22	1.70	...	2.44	19.08
5	26.32	1.49	3.40	2.58	16.54
6	31.43	1.54	3.20	2.30	22.00
7	19.06	.83	3.50	3.16	9.66
8	26.40	1.39	...	2.57	18.90
9	34.30	1.59	...	...	24.34
10	30.04	1.11	...	...	21.72
11	31.83	1.53	...	...	22.64

COOKING:—Catsup, like paste, can be made in steam jacketed kettles, wooden and glass lined tanks with coils or in vacuum pans. No matter what equipment is used in cooking, the proper steam inlets and exhaust should be installed. Small steam inlets require too great a time in cooking which adversely affects the color and flavor, and if the proper outlet for condensed steam is not provided it will cause retardation or removal with the same results, or burning. All steam lines should be installed with lagging to conserve steam which saves coal and keeps water out of the coils and jackets.

In cooking catsup, there seems to be a difference of opinion as to the best manner of handling batches. Tables have been worked out on the specific gravity of the raw pulp showing the amounts of such ingredients as vinegar, sugar, salt, etc., to be used which vary according to the pulp. This means making different weighings of each ingredient entering the batch which might be rather confusing to the average kettleman. Since the pulp is a variable, it is better to keep it so by adding more or less as the case may require, but keep the other ingredients constant and the cook will have less trouble in handling the batches. By this method he will always weigh out the same amount of sugar, salt, vinegar, spices, etc. This enables him to be always ready with his batches. In case he is called away for a short time, there will never be any question as to what amounts should go into a batch, or what amounts have already been added. The tables and methods suggested under pulp can be used in testing the pulp, but the following table has been adapted from it, based on using 120 gallons of thin pulp, i.e., strained tomatoes, of a specific gravity of 1.022 and finished to 55 gallons of catsup. This method of determining the Brix and specific gravity is the same as previously outlined.

Another method which calls for elaborate equipment and more help is more satisfactory in the larger plants. This plan calls for breaking the juice in a separate kettle or tank and cooking down to a definite constant specific gravity, usually 1.035 is the standard. The 1.035 pulp is run into the kettles up to a known volume and the catsup made from it. This permits the most satisfactory control and all batches are always alike.

Glass containers are removed from cartons onto unscrambling table. Cartons are conveyed to case packer for re-use.

Table Pulp Concentration

Brix of Filtrate	Sp. Gr. of Filtrate of Pulp	Sp. Gr. of Whole Pulp	Gallons Pulp to be used
4.10	1.0161	1.0178	148.3
4.20	1.0165	1.0182	145.0
4.30	1.0169	1.0186	142.
4.40	1.0173	1.0190	139.
4.50	1.0177	1.0194	136.
4.60	1.0181	1.0199	132.6
4.70	1.0185	1.0202	130.7
4.80	1.0189	1.0206	128.
4.90	1.0193	1.0211	125.
5.00	1.0197	1.0216	122.
(5.10	1.0201	1.0220	120. Standard)
5.20	1.0205	1.0224	117.8
5.30	1.0209	1.0228	115.8
5.40	1.0213	1.0232	113.8
5.50	1.0217	1.0236	111.9
5.60	1.0221	1.0240	110.
5.70	1.0225	1.0244	108.
5.80	1.0229	1.0249	106.
5.90	1.0233	1.0253	104.4
6.00	1.0237	1.0257	103.
6.10	1.0241	1.0261	101.
6.20	1.0245	1.0266	99.2
6.30	1.0249	1.0271	97.5
6.40	1.0253	1.0275	96.0
6.50	1.0257	1.0279	94.6
6.60	1.0261	1.0283	93.3
6.70	1.0265	1.0287	92.00
6.80	1.0270	1.0291	90.72
6.90	1.0274	1.0295	89.5
7.00	1.0278	1.0300	88.3

Readings taken at 68 degrees Fahrenheit.
If other temperatures are used, apply the correction tables.

IN JACKETED KETTLES:—Cook 125 gallons of pulp in kettles holding about 250 gallons to finish from 50 to 55 gallons of catsup. The kettles are gauged or measured so that an accurate amount of pulp can be used and cooked to a definite end point. If tanks are used, it is well to have a supply tank over the cooker deck so that a definite volume can be measured, thus assuring a standard product. The pulp may be accurately measured by running through a meter or it may be gauged. Such supply tanks should be equipped with stirrers to mix the pulp which will separate on standing. Many prefer kettles in cooking because a small volume is handled and cooked quickly. All kettles should be tinned if possible to prevent the copper being dissolved, as it affects the red color and taste of the product. Often the kettles are coated with an edible vegetable oil before starting to cook in order to help break the foam, prevent spattering, boiling over, and sticking, or burning. In cooking 120 gallons of thin pulp in a kettle, the general procedure is to condense to 80 gallons, then add the sugar, cook to 60 gallons, add the vinegar and finish to 55 gallons. Power stirrers may be installed in the kettles to prevent sticking to the sides.

IN TANKS WITH COILS:—Either wooden or glass lined tanks may be used in cooking catsup. They are made either in 500 or 1000 gallon sizes. The final product necessary to cover the coils is usually about 250 to 300 gallons, depending upon the size used. In order to retain the color the catsup must be cooked quick—never over 45 minutes at the most—[illegible] better. This will require a high steam [illegible]ing should not be started unless the gauge [illegible] 80 pounds, 100 pounds being even better. This does not mean the pressure at the boiler but the actual [illegible]

The coils should be carefully watched to see that the pulp or catsup does not stick or burn and between batches they should be washed with a heavy water pressure or, if necessary, by placing a man in the tank to scrub them. Watch the underside of the coils because catsup will collect there while emptying and cannot be seen and while the coils appear clean on top they may start to burn or stick. This slows down the cooking, requires a much longer time, and will impart a burnt taste to the product and eventually the coils will have to be cleaned with wire brushes, pot scrapers, knives, etc. until entirely bright again. They often are given a coat of edible oil to prevent sticking. Sticking may be attributed to green pulp, low steam pressure, condensed steam in the coils, and traps not working properly. The coils should be connected with cold water so that they can be cooled to prevent burning or sticking, when through cooking. All water must be removed by opening the by-passes before the steam passes to the traps, otherwise the traps are likely to fill up and not function properly, or serious water hammer may result.

The total amount of pulp for a batch can seldom be run into a tank and cooked at once, usually one-half is run in and the balance added slowly, either through a meter or from a measuring supply tank, so as not to check the boiling.

IN VACUUM PANS:—As time goes on, there will probably be more vacuum pans installed in catsup plants. The initial expense of installing and operating make it almost prohibitive for the small manufacturer. While he may want to improve his product, yet his financial condition may cause him to withhold such an installation.

PROCEDURE:—In using a vacuum pan, it is necessary to have at least two pre-cookers or heaters where the pulp can be given a preheating before it is drawn into the pan. If whole spice is used, it should be placed in a bag and tied inside the pan in such a manner that it can not reach the stirrer (if one is present); run in a small amount of pulp or water to cover the outlet at the bottom of the pan; then add the onions and garlic which have been previously ground or chopped fine as well as any ground spice, such as cayenne pepper. Close the pan and draw in part of the pulp that has been previously heated with the required amount of sugar. If the pulp is quite hot, it will be drawn in better under a low vacuum of about 10 inches. A much higher vacuum causes the hot pulp to boil in the line, requiring longer time to be drawn into the pan. When the coils are covered cooking may then be started but care must be observed that the pulp does not foam quickly and be sucked out of the pan into the condensers. When the foaming ceases and the batch is cooking, the balance of the pulp can be drawn in slowly. Often the rate of evaporation is timed so that the incoming pulp is evaporated almost as fast as it is being drawn in. Should the amount of pulp being drawn in exceed the rate of evaporation greatly, there is danger of violent or rapid rising of the pulp in the pan which may necessitate the sudden breaking of part of the vacuum to prevent lossing the entire batch of tomato pulp.

Operating pans require watchful care and should not be left to the ordinary help about the factory. The pulp is condensed to below the proper finishing point to allow for the addition of salt and vinegar which are added last. The salt is dissolved in the vinegar, requiring the addition of a small amount of water to aid in solution before drawing it into the pan. Try to finish the batches above the coils. The best results are obtained on a pan when the temperature is between 130-140° F. with a vacuum of 27 to 28 inches. As the temperature in the pan is about 140° F. during evaporation, the catsup should be heated to about 190-200° F. before emptying. Break the vacuum and increase the heat until catsup has reached the proper temperature.

IN COOKING CATSUP IN OPEN KETTLES OR TANKS [illegible]

when it has started to boil, then add about one-third to one-half of the sugar by scattering over the top so as to prevent its going to the bottom undissolved; this sets and intensifies the tomato color. Then add the ground onions, garlic, and cayenne pepper; the spices may be scattered loosely in the batch, but better results can be obtained by cooking the whole spice in bags. Add the rest of the pulp slowly so as not to check the boiling and when the pulp has condensed to about one-half its volume, add the balance of the sugar. Add the salt by scattering so that it will not go to the bottom undissolved, just before adding the vinegar. Salt is not added until near the finish as it has a tendency to bleach the color and also aid in dissolving copper from the kettle or coils. A little scattered on the surface of the catsup during a temporary shut down will prevent oxidation or darkening on the surface.

MATERIALS ENTERING INTO CATSUP:—A series of practical tests have demonstrated that no one ingredient prevents the spoilage of catsup, but it takes a combination of all ingredients in the proper proportions, handled under sanitary conditions, starting of course with clean pulp.

Before the food laws were enforced, manufacturers depended greatly upon preservatives to keep their products from spoiling, but since then publicity, coupled with modern sanitary methods of handling, has shown the manufacturer that he can make food products such as catsup that will keep without the use of preservatives. Benzoate of soda in $\frac{1}{10}$ of 1 per cent is not sufficient to keep any one product from spoiling, but its presence in addition to clean pulp, sugar, salt, vinegar, and spices will aid in keeping it from fermenting. The product containing benzoate need not be so highly concentrated nor spiced as heavily. Catsup for restaurants is often preserved as it receives more severe handling than other lines of foods. When one realizes the abuse this product receives, it is surprising how well it stands up. Bottles may be alternated between the ice box and warm dining rooms; partly emptied bottles refilled with fresh catsup and bottles never emptied for weeks.

SALT:—The salt used should be clean and free from dirt. The same tests should be applied to this salt as are applied to salt for pickles. Store it in a dry place to prevent caking. Avoid contact with iron or any rusty utensil when handling.

VINEGAR:—100 grain white distilled vinegar is used in catsup as it contains more acidity and does not require a long cooking to reduce the volume, as a vinegar of lower strength, such as cider vinegar. Storage space can also be economized by its use. Should 110 grain vinegar be used, then a proportionately less amount should be added, but if a 90 grain is used, a proportionately larger amount should be added. An 80% commercial acetic acid, which is the equivalent of 800 grain vinegar, has been used in catsup, but it is considered an adulteration and its presence must be stated on the label.

Acetic acid is now being produced without the impurities that were formerly present in the 80% acid. One gallon of 80% acid will take the place of 8 gallons of 100 grain vinegar. There is no doubt that it is a better preservative than 100 grain vinegar when diluted to the same acidity, as there is evidently some substance present in very small amounts that aids in preserving—possibly some creosote compounds in very minute quantities. A 100 grain white vinegar can be shipped in tank cars more economically, especially if the manufacturer has his own railroad siding. Vinegar emptied from barrels should be strained to remove paraffine, chips, charcoal, burlap, and anything that might have been in the barrels when they were filled.

Test all vinegar received before using. If it has been shipped in a tank car that previously contained say a 50 or 60 grain vinegar, then the 100 grain will be reduced in strength due to osmosis. The same applies to barrels and storage tanks at the plant. Vinegar should be checked for metallic contamination such as copper, iron, and zinc. Never try to use a steam siphon in handling it, but a motor driven brass or bronze pump may be used to transfer it from the car or barrels to storage using either enameled, tin lined or wooden pipe. Never use iron or galvanized iron pipes.

Jars of tomato catsup traveling through continuous cooler, in which they are subjected to cold water spray from nozzles.

Acidity of catsup varies often from less than 1% to as high as 2.25%. The average catsup will contain from 1.25-1.50% of acidity, and will assure its stability when opened. A higher acidity necessitates the addition of more sugar to counteract the sourness. The tendency today is to increase the sugar as it will aid in increasing the red color. The public seems to prefer a sweeter catsup.

One gallon of 100 grain vinegar will weigh approximately 8½ pounds.

ONIONS AND GARLIC:—The onions used usually have the rootlets and tops cut off with loose outer leaves removed. Garlic buds are usually broken apart. Run products through a food grinder or chopping machine. The finisher will remove any skin so that it is not necessary to peel the onions. If desired they can be mechanically washed and peeled in a vegetable peeling machine.

Garlic being quite strong requires but little to give the proper results when used with onion. Onions may be omitted and more garlic added to replace it without making apparent any of the strong garlic taste which is offensive to some people.

One ounce of ground garlic is equal to 1½ pounds of onions.

Garlic may be ground or chopped and placed in barrels when it can be obtained at a reasonable price. One-half barrel of ground garlic is covered and mixed with a half barrel of 100 grain vinegar. Store until ready to use. Use 2 ounces of this garlic preparation to replace one ounce of the dry garlic.

SPICES AND SPICING:—The best flavored catsup is obtained when but a few spices are used; the success of cooking lies in the proper blending of raw materials so that no one spice predominates, nor should a preponderance of spice mask the natural flavor of the product. Spicing of catsup may be done by using whole spice, ground spice, essential oils, or oleoresin of spices. Spices should be stored in dry, cool places to prevent the loss of volatile oils and molding. Paprika, cayenne, mace, and cinnamon will mold if kept in a damp warm room. Only the immediate needs should be kept in the cook room. If it is necessary to keep spices over until the next season they may lose considerable volatile oil unless packed in airtight containers.

GROUND SPICE:—It is not advisable to use ground spice because it is thrown directly into the batch and very little is removed by the finisher. Ground spices, formerly were adulterated with ground cocoanut shell, olive stones, sawdust, etc., but government inspectors have curbed this practice. Ground spice is the entire spice ground and in addition may contain the siftings from whole spice. As spice usually contains considerable tannin, this of course remains in the finished product resulting in a dark product. This particularly applies to such spices as cinnamon, cloves, and allspice, but not to peppers or mace. Catsup cooked with ground spice seems to have a more pronounced flavor upon aging for any length of time, in fact, it may be too pronounced. About one-half of the oil of the spice is extracted in cooking and all of this does not remain in the catsup as part of it is volatilized, this should certainly be taken into consideration when using ground spice.

WHOLE SPICE:—Cinnamon, cloves, celery seed, allspice, and mace are used in spicing catsup. The weighed spices are placed in bags or a perforated can and either dropped into the pulp or held in place by being tied to the coils or held underneath the surface of the pulp to assure extraction and blending of the flavor. When cooked loose in a batch, the spices are likely to clog the outlet pipes and prevent the flow of the catsup from the kettle. Also loose spices are brushed against the finisher screen cutting off very minute particles which have a tendency to cause darkening. When cooked in bags, the same spice is often used in two, or three batches to obtain a smoother flavor. Allspice should not be used as it is very high in tannin and aids in darkening the product. If an allspice flavor is desired, use a small amount of oil of pimento (allspice)—two-thirds of an ounce per 125 gallons of finished catsup. Mace and ginger, if used, are usually added several minutes before the batch is finished because the volatile oils of these spices are readily driven off by cooking. The broken and sifted Saigon Cinnamon is used in catsup because of its cleanliness and fine flavor. This grade of cinnamon is, however, getting rather scarce and expensive. The thin young bark has better flavor but is more expensive. China Cassia is much cheaper, but does not have the delicate flavor. It contains more essential oil, but the oil is stronger and harsher.

All spices received should be analyzed to determine whether or not they come up to the sample submitted. General appearance and salesmen's statements should not be used as a buying basis; either chemical or actual practical tests should be used. Samples submitted may seem perfectly all right microscopically, but if subjected to tests one may find they have been "doctored," i.e., they have been exhausted and then given a light coating of oil. The sample at first may taste quite strong, but if kept in the mouth for a short time will have no flavor.

CLOVES:—"Headless" Penang Cloves are used because of the flavor and cleanliness. The heads of cloves contain considerable tannin and in order to avoid discoloration, headless ones are used. Some use Zanzibar, Pemba, or Amboyna cloves with good results.

PEPPER AND MUSTARD:—These spices are often both added to produce a "hot" taste to the catsup, southern trade being especially fond of a catsup that is quite peppery. Ground Cayenne or ground mustard is added direct to the batch when cooking. Ground red peppers in vinegar packed in barrels may also be added to produce the same effect.

MACE:—This spice is used in combination with other spices to produce a smoothness. The varieties used are usually Penang, Batavia, and Macassar, but the Bombay or wild mace is considered an adulterant.

while it has a mild, sweet taste, its use in catsup is usually to hide or mask poor color of the pulp. It produces an entirely different taste in the product when used and changes the delicate spicing. Unless paprika is a brilliant red, it has very little coloring value except when used in such quantities that the flavor is altered. In using paprika, some think it should be boiled in water and allowed to stand over night; some soak the paprika in the vinegar for each batch; while others add it direct to the pulp when they start to cook.

Ground sweet red peppers may be used to produce a red color, but the amount used is usually so great that the product does not have a good tomato flavor. The peppers can be ground extremely fine by running them through mustard mills, or through the very fine plates of the food grinder.

A chemical examination of certain spices before and after being cooked (in a batch) shows that about one-half of the oil remains in the spice even after being cooked for about one hour at from 212°-215.5° F. The results obtained do not mean that the other half of the spice oil extracted remains in the catsup. There is no accurate data published on this subject.

Analyses of Cinnamon and Clove Before and After Being Cooked in a Batch of Catsup

	CINNAMON		CLOVES	
	Before	After	Before	After
Total ether extract	7.20%	3.80%	30.50%	14.40%
Fixed oil	3.90%	2.65%	12.55%	8.00%
Volatile oil	3.30%	1.15%	17.95%	6.40%
Ash	5.75%	2.55%	5.80%	5.75%

Generally the spices are thrown away after being cooked. They can be washed thoroughly to remove any pulp and sugar, and then spread out to dry either in the open or in a low temperature drying oven and later used for pickles or extracted for the residual oils.

SPICE OILS AND OLEO RESINS:—When spice oils are substituted for the whole spice, a saving can be effected with very little change in the spice flavor. Oils are being used successfully in the manufacture of catsup and chili sauce instead of using whole spice. One great advantage in the use of oils is that no tannin is introduced; sufficient oils for the entire season's production can be carefully blended at one time and a uniformity of flavor and quality is assured. By using oils the color is often better than catsup made with whole spice and the finished product does not darken upon standing. While catsup made with spice oils seems to lack the same smoothness as catsup made with whole spice, yet it would take an expert to detect any marked difference. The average consumer cannot detect any difference, and it is to him that the manufacturer looks for approval or condemnation of his product. Persons who are experts have sampled catsup made with whole spice and with oils and have selected the latter as being better.

The spice flavor in whole spice is entirely due to the fixed and volatile oil—so-called oleo resins. Oleo resins can be obtained commercially, and as they contain the entire flavoring principle extracted from the spice without the presence of the objectionable tannin, their use in catsup is gaining. In adding the resins, the best results are obtained by mixing them with a heavy syrup and then adding to the batch just after the completion of the cook in order to avoid loss by volatilization. Cook no longer than one-half minute in order to blend or incorporate. Oils may be added directly to the batch by carefully scattering over the surface or by mixing them to a small quantity of sugar and then add to the batch. Cook the same as when using oleo resin. Running the catsup through the finisher and into the receiving tank will blend and mix the oil. Oils may also be used in conjunction with whole spice seasoning.

A comparison of the strength of whole spice versus the essential oil of the same spice is herewith given

Essential Oils vs. Whole Spices

100 Pounds	Pounds of Oil
Allspice, equals	3½
Cassia bark, equals	1
Cardamon seed, equals	3
Celery seed, equals	2
Cinnamon Ceylon, equals	½
Clove buds, equals	15
Coriander seed, equals	¾
Curcuma (turmeric), equals	4
Dill, equals	2½
Estragon herb (tarragon), equals	⅛
Fennel, equals	2½
Ginger, equals	¼
Laurel leaves, equals	1
Mace, equals	3½
Marjoram, equals	½
Mustard seed, equals	¼
Nutmeg, equals	5
Parsley grain, equals	2
Pepper, equals	1
Pimento berries, equals	2½
Star Anise, equals	1½
Thyme, white French, equals	2
	Pounds Oleo Resin
Capsicum, equals	5
Ginger, equals	5

From this one can readily see that a small amount of essential oil will replace the whole spice.

Practical commercial tests demonstrate that spices have very little if any preserving or antiseptic property when used in catsup. The amount of spice necessary to preserve would have to be so great that the product would be unpalatable.

FINISHING POINT:—Practical cooks can tell by the general appearance when a batch is finished; it has taken them years to tell by the eye when the product has been concentrated enough by its drip from the dipper or by placing a sample on a board and observing whether it runs or "weeps." Some start with a certain volume of pulp and concentrate to a fixed volume by using gauge sticks. This method will usually insure a uniform product, especially if the amount of raw pulp added is based on its specific gravity. The kettles or tanks should be gauged accurately either by weighing the water or using a water meter. Measurement of the finished product, if being taken on the hot catsup, the gauge of the kettle should be in hot water otherwise the measurement will not be correct.

Copper weighing cups have never given very satisfactory results on account of the air present and rapid cooling, although they are still used by some manufacturers.

A special Beaumé hydrometer used in testing pulp can be used in testing the catsup with very good results. It may require cooking a few batches to determine the desired end point on the hydrometer. By testing the cold catsup and determining the specific gravity of the one with the proper consistency and knowing the Bé. test on the catsup when hot. it can be taken as the standard and all batches cooked alike.

Should the salt and sugar or the volume of the finished catsup be changed it will be necessary to recheck both the hot and cold catsup again to redetermine the proper standard.

Either an Abbé or Immersion refractometer can also be used in checking the solids of catsup. The Abbé, which requires but a few drops is very accurate and rapid. Some of the newer Abbé refractometers have an additional scale reading the per cent sugar direct. This instrument is being used more for testing than any other method today. The catsup should be tested cold with this instrument and then heated in the bottle and tested while hot so that a comparison between the cold and warm catsup can be obtained. Each manufacturer must standardize his own product because a variation of sugar and salt will affect the refractometer readings and as long as he standardizes his finished catsup he can always cook to that point. The Immersion is very good but takes longer and is used more for laboratory analysis than for cook room control.

In using an Immersion refractometer each manufacturer will have to work out a factor to suit his product as sugar, salt, and vinegar will cause variations in the readings. While there may be a slight difference, due possibly to slight inaccuracies in weighing sugar, salt, and vinegar, these discrepancies will not affect the accuracy greatly. The following formula has been applied to the Immersion Refractometer using the filtrate of tomato catsup:

R = Rw x 1.622 = per cent total solids. (68° F.) In which:

R = Refractometer reading of water at 68° F.

1.622 is a factor obtained by averaging the total solids of a great many determinations made in vacuum at 70° C.

The method used is as follows:

Weigh 10 grains of catsup quickly and accurately, then add 50 c.c. of ice water (distilled) from a cooler, mix thoroughly, filter through fluted paper, cool in immersion water bath for about 5 to 10 minutes to constant temperature making the necessary corrections for 20° C. The dilution is 6 to 1.

The following are results obtained for the season's work on total solids in vacuum as well as refractometer readings of the filtrate at 20° C.:

$$\frac{R - Rw \times \text{Dilution } (6:1)}{X} = 25.21$$

Therefore, X = 1.622

or, $\frac{30.09 - 14.55 \times 6}{X} = 25.21$

The total solids can be determined accurately by using the vacuum oven but this requires laboratory apparatus and considerable time.

CATSUP FROM PULP:—Today's processor realizes that the sooner he converts his raw material into a finished product the better the color and flavor with less trouble and expense involved. Sometimes, due to an over supply of tomatoes on hand he is compelled to pack some of the pulp in cans to be manufactured into catsup. Toward the close of the season receipts may be light, with color poor so that if he has any pulp of a good color it can be blended advantageously with pulp from fresh tomatoes, thereby improving the flavor. The more pulp is handled and cooked the poorer the resulting product. Catsup made from canned pulp will have a poorer color and flavor than if it were immediately cooked into catsup.

Many manufacturers are wondering why they cannot produce a brighter and more uniform color in their product similar to some of the larger manufacturers. They do not realize that perhaps the competitor in question has spent a fortune in controlling his product, starting with the proper seed used to grow the tomatoes; the kind of soil, location of factories, and careful supervision to see that tomatoes are of the proper ripeness and are free from decay and rot. Also that the best and latest equipment is installed for washing, sorting, and pulping. They do not realize that the company in question knowing the importance of quality, tries always to keep its product uniform, irrespective of cost.

Brown or poor color in catsup may be due to green (unripe) tomatoes that were either grown under unfavorable weather conditions or picked too green. As has been mentioned under pulp,—sunshine and warmth are quite essential to produce color.

Also poor color in catsup may be caused by cooking too long or too many times and thus burning or scorching the

product. This applies when catsup is made from pulp which has been handled and cooked a number of times. Thick cold pulp has a tendency to stick or burn on the kettle or coils and if used must be stirred constantly. It is often the practice to bottle the poorer colored catsup in small bottles as it is quickly consumed and the color does not appear quite as bad as when it is packed in larger packages. During that part of the season when the tomatoes have the best color, endeavor to fill the red catsup into large packages.

The use of full red ripe tomatoes not only gives a good color to the finished product but also provides more natural tomato pectin for the finished catsup. Heating in a breaking tank destroys the enzyme present and prevents the change of pectin to pectic acid; whereas the cold pulp system crushes the tomatoes and, in so doing, incorporates a great deal of air as well as exposes the juice to the air so that the enzymes present have an opportunity to act on the pectin and change it to pectic acid. This enzyme is easily destroyed by heating to at least 170° F. The hot cooking also dissolves some of the soluble parts of the tomato seeds. Pectin if added to catsup must be declared on the label.

THICKENERS:—Very few thickeners have been used in catsup in recent years. Gum Arabic, Gum Tragacanth and Gum Karaya (Indian) were used in small amounts, but their presence must be declared. Since the advent of pectin, either powdered or as concentrated liquid, some is being used. The powdered product is added at the rate of 1/10 to 2/10 of 1%. Mix the powdered pectin with about 4 or 5 times its weight of sugar, and add it near the end of the cooking so as not to hydrolyze. The use of thickeners is considered an adulteration because the proper thickness can be obtained by proper cooking without the addition of them. Added pectin is a very unsatisfactory thickener at the best.

BLOTTER TEST:—This test is often used by some manufacturers as a selling point for their catsup. In using the test a small portion of their own catsup as well as that of their competitors is placed on a white blotter and in a very short time, the results are compared. Invariably their own catsup still retains its original form and does not flatten out and show a water ring surrounding the mass, as does their competitors.

It has been thought that catsup standing up under this test contained fillers such as gums or pectin. Tests show that no gums were added as thickeners. The method of producing the pulp by cooking the tomatoes in breaker tanks until quite soft and then cycloning through two machines removes all of the tomato fiber and soluble solids. Proper handling will extract all of the vegetable gums or pectins present in the tomatoes, thus making it unnecessary to add any pectin. The breaker tank method of heating or cooking the tomatoes before cycloning destroys the enzyme present in the tomato so that any pectin present is not destroyed but extracted to give the best thickening power.

If a manufacturer's catsup shows a high viscosity and high pectin content and he is using the cold pulp method, one is almost safe in accusing him of adding pectin. One must actually know the process used in that particular plant.

CATSUP FORMULAS:—As the spicing is changed frequently by small manufacturers due to the change of cooks the flavor will probably vary. Small companies may require only the services of a cook during the tomato season, consequently each year will bring a new cook with new formulas. Most processors are getting away from this method since competition has been so great and good cooks so scarce that for their own protection they are compelled to have one cook always in charge who knows the business.

Formula A

Tomato Pulp, specific gravity 1.020	330 gallons
Sugar	120 pounds
Salt	27 pounds
Vinegar, 100-grain white distilled	7 gallons
Cloves—headless	15 ounces
Cinnamon—broken and sifted	15 ounces
Mace	1 ounce
Cayenne Pepper	5 ounces
Garlic, freshly ground	25 ounces
(or) Onions, 28 pounds and Garlic	5 ounces
Cooked to a finish of	125 gallons

(This makes a mildly spiced product)

Formula B

Tomato Pulp, specific gravity 1.020	800 gallons
Sugar	480 pounds
Vinegar, 100-grain white distilled	36 gallons
Onions, ground	136 pounds
Cloves—headless	2 pounds, 9 ounces
Allspice	3¼ pounds
Cinnamon, broken and sifted	3¼ pounds
Mace	3¼ pounds
Cayenne Pepper	1 pound
Cooked to a finish of	350 gallons

(A good average catsup)

Formula B increases the solids by the addition of more sugar with more vinegar to offset the sweetness.

Formula C

Tomato Pulp, specific gravity 1.022	600 gallons
Sugar	300 pounds
Salt	50 pounds
Paprika	8 pounds
Onions, chopped or ground	10 pounds
Garlic	2 pounds
Mace	12 ounces
Cinnamon, broken and sifted	10 ounces
Cloves—headless	12 ounces
Cayenne Pepper	13 ounces
Vinegar, 100-grain	16 gallons
Cook to a finish of	200 gallons

(This makes a spiced catsup with a good color which of course is partly due to the paprika.)

Formula D

Tomato Pulp, specific gravity 1.022	120 gallons
Sugar	70 pounds
Salt	13 pounds
Vinegar, 100-grain	5 gallons
Onions, ground	13 pounds
Cinnamon, broken and sifted	2 pounds
Cloves, headless	1 pound
Paprika	1 pound
Powdered Mustard	2 ounces
Cayenne Pepper	1½ ounces
Cook to a finish of	55 gallons

Formula E

	(A)	(B)
Tomato Pulp, S. G. 1.020	700 gals.	700 gals.
Sugar	350 lbs.	or 450 lbs.
Vinegar, 100-grain distilled	16½ gals.	or 28 gals.
Salt	87½ lbs.	87½ lbs.
Onions, peeled	58¾ lbs.	58¾ lbs.
Garlic, freshly ground	8¾ ozs.	8¾ ozs.
Cayenne Pepper	8¾ ozs.	8¾ ozs.
Cinnamon, broken and sifted	58⅓ ozs.	58⅓ ozs.
Cloves, headless	46⅔ ozs.	46⅔ ozs.
Cook to finish of	800 gals.	800 gals.

(This formula makes a high grade catsup)

quality. This is one of the reasons for the great success of the largest food companies in the world today, and besides they have experimented for years perfecting formulas before any product is placed on the market. Once established, the uniformity is never changed. A well-blended product can be obtained by using a few different spices such as cloves, mace, celery seed, and cayenne pepper. It is principally a matter of taste.

These formulas are all commercial ones that are being used successfully. The general procedure is as follows:

If the cooking vessel is not large enough, add one-half of the pulp and bring to a boil, adding the whole spice in a bag and the ground spice loosely, then the garlic and onions and scatter about one-third of the sugar so it will not go to the bottom undissolved; concentrate about one-half and add the balance of the sugar; cook to near the end point before adding the salt and then cook to below the end point so that after the vinegar has been added and cooked for at least two minutes, the proper end point will be obtained. This cooking is necessary to remove the harsh taste in the product due to the raw vinegar.

ESSENTIAL OILS IN CATSUP:—The following amounts of essential oils can be used to replace whole spice. Ground spice such as Cayenne is added to the batch in order to give hotness. (Capsicum, the oleo-resin fo Cayenne pepper, can be used, but it is so powerful that it is likely to be added in too great a quantity.) The amounts used are based on a completely finished batch of 125 gallons and produce a very good catsup.

Oil of Clove	40 c.c.
Oil of Cassia	30 c.c.
Oil of Pimento	25 c.c.

The following is also a good blend of oils to use. Blend together the following oils and use 3 ounces per 125 gallons of finished catsup:

Oil of Clove	33 ounces
Oil of Cassia	3 ounces
Oil of Mace	10 ounces
Oil of Pimento	11 ounces

In adding the oil to a finished batch, slowly pour it over the surface of the catsup after the steam is shut off; then turn the steam on full for about one-half minute to blend properly. The oil can be mixed with a small amount of sugar and this scattered over the surface of the product so that as the grains of sugar coated with oil sink into the catsup as finely divided particles, the oil is disseminated throughout the batch.

OLEO-RESIN:—This product on account of being thick and viscous should be mixed with syrup before being added to the finished catsup and handled in the same manner as essential oils, or it can be mixed with sugar first.

Use 1 ounce oleo resin Clove, 1 ounce oleo resin Cassia per 100 gallons of finished catsup.

SPECIAL CATSUP:—Tobasco Catsup can be made by adding ¾ gallon ground tobasco peppers and increasing the cayenne 50% in a finished batch of 250 gallons.

OYSTER COCKTAIL CATSUP:—This can be made by mixing together 50 gallons of finished catsup, 12 pounds of dry horseradish, 6¼ pints of 100 grain vinegar, 3¾ pounds of salt and 5½ ounces of cayenne pepper. As horseradish is not stable, this product will lose strength on standing and only small quantities for immediate sale should be prepared. This is a very good product for any company that does a local business, but from a strength standpoint it should never be guaranteed for long periods.

FINISHING:—After the batch has been cooked to the proper density, it should be immediately emptied to prevent further cooking and darkening. It can be run into a storage tank and then through a finisher or through the finisher direct from the cookers. The finisher should be placed as near the kettles as possible in order to avoid long piping and rapid cooling. The lines should have as great a pitch as possible to facilitate emptying quickly. If the flow is too slow, larger pipes or a pump must be used.

The finisher, having a fine screen with perforations of 0.027 inch or 0.033 inch in diameter, will remove any tomato fiber not removed by the pulping process, and small pieces of paper or wood that might have gotten into the product from the sugar or the spice in case a bag has broken.

The screens were formerly made of brass and during the interim between batches the acid from the catsup on the screen would dissolve a slight amount of zinc and copper. Any catsup clinging to the end of the screen will have a decided metallic taste and be brushed into the next batch. Brass screens were formerly tinned or silver plated, but it was soon worn off by the constant rubbing of the brushes. Nickel-alloy metal screens were substituted, giving a longer life and not imparting the objectionable metallic taste. Any interim between batches will permit the washing and steaming of the finisher in order to make a more sanitary product and remove any danger of metallic contamination.

VISCOLIZER:—If the catsup from the finisher is run through a viscolizer, the fine particles of tomatoes are broken down to an exceptional product free of any particles and should stay in suspension without any separation. This will break down the tomato cells. The product can then be stored in insulated tanks for filling.

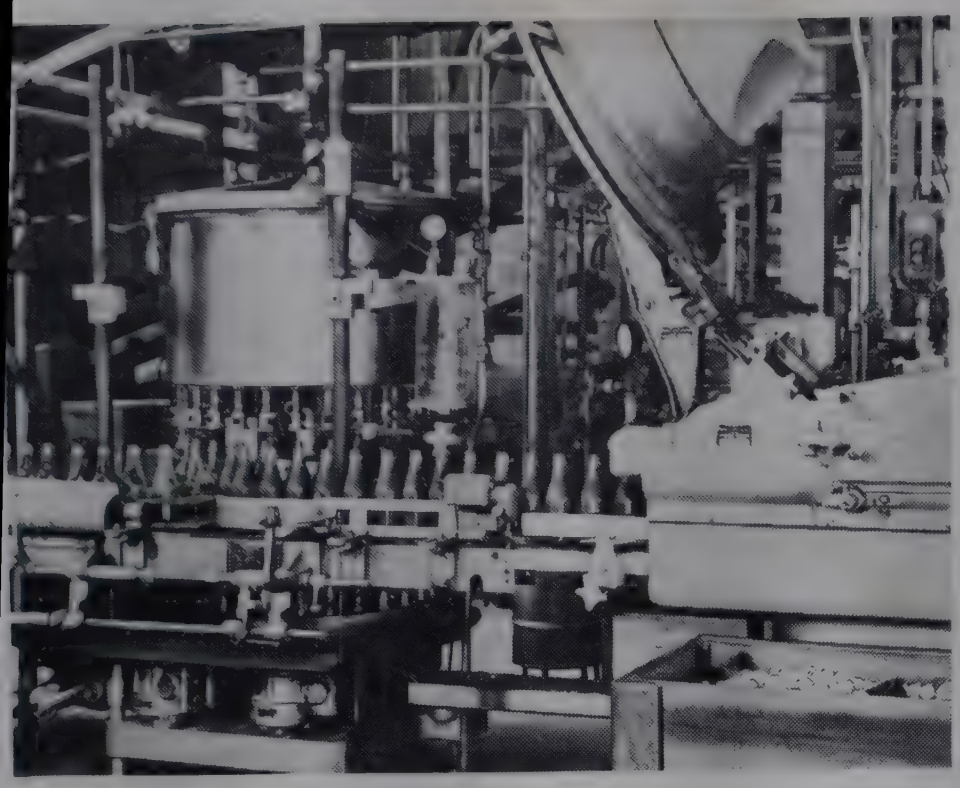
STORAGE:—The catsup from the finisher should be conveyed either by gravity or bronze pumps through tin lined pipe or through enameled lines to a storage tank made of wood or glass lined. Storage tanks should have a heating arrangement in order to keep the catsup hot. Coils are installed and in addition to these, thermo-regulators should also be attached to the tank in order to keep a constant temperature. Hot water is better for heating storage tanks than steam, for it will not boil the catsup. Recording thermometers can also be installed, but they are not so important when thermo-regulators are provided.

WASHING GLASS CONTAINERS:—All jars received must be washed. Jars received in bulk or re-shipping cases usually contain some dust or dirt and should be washed or steamed. A great amount of breakage will occur unless the bottles have been given a preliminary heating before filling. After filling and capping, they are also given another washing with clean water by either passing them through a bath or by spraying to remove catsup clinging to the outside of the container. This prevents the catsup from drying on the hot container, thus avoiding the difficulty of cleaning dirty jars at some later period. Jars that are to be processed are not washed before processing.

FILLING AND CAPPING:—Modern catsup plants are now largely equipped with automatic filling and capping devices. They are so arranged that the empty bottles are automatically fed to the filler, and then through the capper, both being operated at the same speed.

Catsup manufacturers have always used small neck bottles not considering that years ago, catsup had low solids and was rather thin, whereas today with high sugar, solids, and viscosity it is almost impossible to pour from such bottles without spilling it over everything. With the great attention today to packaging all kinds of products, it would be well for the catsup manufacturer to re-design his package to one with a large opening similar to a chili sauce bottle. One manufacturer has already changed to a larger necked bottle.

The caps for sealing catsup are either plain or of an easy



Automatic filling and capping of catsup bottles. Vacuum capper, right, injects steam. It condenses to form vacuum under cap.

Empty cases from unscrambling room meet jars of catsup as they leave continuous cooler. They will be labeled later.

opening character. Cap liners that do not have pinholes in the cork have become very expensive. The pinholes invariably contain fine cork dust (tanin) which is drawn onto the surface of the catsup when the hot bottles cool to form a vacuum. It is this cork dust coupled with air leaking in the bottle through the perforation as well as iron present in the catsup that is one of the causes of "black neck." Composition Cork, composed of small pieces of clean cork cemented together with a binder, is now used as a liner for the crowns.

In stacking catsup, invert the bottles or lay them on the sides which keep the seals moist so that they will not dry out and permit air to enter the bottles to cause "black neck." Leaky seals are the greatest cause of this trouble.

An examination of "black" catsup sealed with crowns that have whole cork inserts will with but few exceptions, show perforation. "Black" catsup is not always caused by the cork. If the catsup is packed into fiber boxes after being filled, the paper case acting as a fireless cooker permits a slow caramelization of the sugar.

PROCESSING:—As an extra precaution and safeguard, catsup may be given a pasteurization either in tanks or continuous pasteurizers. If the raw material is clean and handled rapidly under sanitary conditions, then pasteurization can be omitted. However, if it is omitted the product going into hot bottles must have a temperature of at least 190° F., although, 200° F. is better.

Table of Pasteurizing Temperatures

6 to 8 ounce bottles 20 to 30 minutes at 190° F.
10 ounce bottles 30 minutes at 190° F.
16 ounce bottles 45 minutes at 100° F.
1 gal. glass or metal containers 1 hour at 190° F.

PROCESSING vs. NON-PASTEURIZING:—Most of the modern plants are being equipped to handle their product without pasteurizing. Pasteurizing means extra equipment, extra handling, more steam and, therefore, extra expense and greater loss due to breakage. When the non-process method is used hot catsup is filled into clean hot bottles. Unless a thermometer is installed in the supply tank it will require careful [illegible] supervision almost constantly to see that the product is at the proper temperature. This permits the presence of the right temperature is not dependent upon judgment of error and the labor saved will [illegible]. The product should enter the [illegible] pasteurizer hot-

ing. Spray with hot water after capping and either label or stack until they can be labeled.

SEPARATION:—Catsup that has been pasteurized will often show a marked separation, the tomato fiber near the top of the bottle and a very watery solution about half way down. This condition is due to the heating, just the same as pulp separates when slowly heated. While it may involve a little extra labor, the catsup can be shaken to mix the pulp and water and overcome the trouble. This condition may also occur when bottles of hot catsup are stored in cases. Water often collects in the neck of the bottle on the surface of the catsup, this being especially true when catsup is packed hot into fiber containers. The vaporized moisture is condensing and falls back on the surface. If catsup is to be packed into cases, it should be packed upside down to avoid separation, condensed water, and "blackening." Each time the cases are moved they should be turned up side down to assure thorough mixing.

STACKING:—As the catsup season is an intensive one, time and labor may not permit the labeling and shipping as a continuous process so that the filled bottles are often piled on the floor of warehouses. If the floor is concrete, boards should cover it to prevent breakage with the filled cases stacked about four feet high. The storage space should be well ventilated or equipped with fans to draw off the intense heat or the product may "stack burn" or turn dark. Stacking in strong slatted crates gives better cooling.

FREEZING:—When subjected to low temperature, catsup freezes; the freezing points depend upon the amount of sugar, salt, etc., present. A sample of catsup containing 20% sugar began to freeze at 15.6° F. and was solid at 14° F. Upon thawing, it assumed a muddy color but showed no signs of separation. Breakage is likely to occur when the product is frozen so that it is advisable to protect the product from this condition.

FERMENTATION:—Spoilage is caused principally by yeast and bacterial fermentation due to unsound tomatoes, insanitary conditions about the plant, as well as insanitary methods of handling, improper filling temperatures and leaky closures. The last two are the most important. If the above reasons were eliminated, the loss due to spoilage would be reduced to a minimum. Bacterial fermentation may be caused by lactic acid bacteria.

Insanitary methods will never produce good clean wholesome food. The workers and the equipment must be clean

The use of plenty of hot water, steam and soda solutions aids wonderfully in keeping the premises clean. All waste materials should be removed at least once a day. Wood should be avoided wherever possible as the rough surface is a very good place for the development of yeast, mold spores and bacteria.

YIELDS:—44 bushels of tomatoes of 60 pounds each (2640 pounds) should yield 264 gallons of pulp with a specific gravity of 1.020, or 150 gallons of a 1.035 pulp, and produce 100 gallons of catsup with solid content of about 25% with acidity 1.20 per cent and specific gravity 1.123. It therefore requires 2.63 gallons of thin pulp to produce 1 gallon of catsup. 32 cases, 2 dozen each, 14 ounce may be produced from 1 ton of tomatoes. 55 to 60 cases, 2 dozen each, 8 ounce, may be produced from 1 ton of tomatoes.

Suggested Label Weights (Net Weight)

Tomato Catsup		Lbs.	Ozs.
33 percent solids (Sp. Gr. 1.15)			
8Z Tall	211 x 304	.	9
No. 1 Picnic	211 x 400	.	11½
No. 1 Tall	301 x 411	1	2
No. 303	303 x 406	1	2
No. 2	307 x 409	1	6
No. 2½	401 x 411	2	.
No. 10	603 x 700	7	3
25 percent solids (Sp. Gr. 1.11)			
8Z Tall	211 x 304	.	9
No. 1 Picnic	211 x 400	.	11
No. 1 Tall	301 x 411	1	1
No. 303	303 x 406	1	1
No. 2	307 x 409	1	5
No. 2½	401 x 411	1	14
No. 10	603 x 700	6	15

Tomato Paste		Lbs.	Ozs.
25 percent salt-free solids (Sp. Gr. 1.11)			
6Z	202 x 308	.	6¼
No. 2½	401 x 411	1	14
No. 10	603 x 700	6	15
33 percent total solids (Sp. Gr. 1.14)			
6Z	202 x 308	.	6½
No. 2½	401 x 411	1	15
No. 10	603 x 700	7	2

Tomato Puree			
8.37 percent solids (Sp. Gr. 1.035)			
8Z Tall	211 x 304	.	8¼
No. 1 Picnic	211 x 400	.	10½
No. 2	307 x 409	1	3
No. 2½	401 x 411	1	12
No. 10	603 x 700	6	8
11 percent solids (Sp. Gr. 1.045)			
8Z Tall	211 x 304	.	8½
No. 1 Picnic	211 x 400	.	10½
No. 2	307 x 409	1	4
No. 2½	401 x 411	1	13
No. 10	603 x 700	6	9

Chili Sauce

Chili sauce is the sound, clean, cooked product made from chopped, peeled, ripe tomatoes, chopped pepper, salt, sugar, spices and vinegar, with or without onions and garlic.

It can be made from freshly peeled tomatoes, canned tomatoes, or peeled tomatoes with added pulp.

A machine, called a chili sauce pulper, is used to remove the skins from tomatoes. It seems to break the tomatoes into small pieces, whereas peeling by hand, while rather expensive, produces a much nicer looking product.

Chili sauce made from pulped and canned tomatoes is usually rather finely broken up without showing the presence of many large pieces.

The tomatoes used in making chili sauce should be large, firm, and well ripened, and have little waste when peeled. They may be selected from shipments that are exceptionally good or all of the tomatoes may be run over the sorting belt where the best ones are picked out and diverted to the scalder and peelers or the chili sauce machine. The peeled stock should be rigidly inspected to see that all the skin and green cores have been removed. This is very important.

In some factories these peelings are run through the cyclone machine along with the regular pulp. Should these peelings be used, careful inspection of the tomatoes should be made to remove any decayed ones. Most of the mold grows on or near the surface and its removal with the peeling to make mixed pulp is simply inoculating good pulp with bad, and this practice should be discouraged. Remember that 8-10% of bad tomatoes will do more harm than can be offset by the additional 90% of good material and may cause the mold count to exceed the U. S. limits.

Chili sauce made from canned tomatoes is very good, but the product has very few large pieces because processing has so softened the tomatoes that they readily cook to pieces. When whole pulp is added to cheapen the product, a rather soft and mushy product results, which does not have the fine appearance of chili sauce made from freshly peeled raw tomatoes.

The raw materials used in making chili sauce are about the same as those used in catsup. The onions and garlic used should be carefully peeled and chopped very fine as they are thrown directly into the batch. Spices used are whole and should, with the exception of cayenne pepper and paprika (if used), be placed in strong bags that will not break. A breaking bag causes the spice to mix through the batch so that it must then be run through a catsup finisher and blended with catsup if it is to be saved.

Chili sauce being made from ripe, well colored tomatoes, the natural color is intensified by sugar and concentration so that the addition of paprika is unnecessary. Paprika imparts a peculiar sweet taste that is not pleasing and need not be used if conditions are right.

The same sanitary methods applied in making catsup should be maintained.

There should be less spoilage in chili sauce than in catsup because the raw material is almost perfect, and peeling will remove any blemishes. All peeling buckets should be washed and scalded before being returned to the peelers. The peeled

Catsup is pumped from holding tank to deaerator (foreground). Here air is removed to prevent discoloration and "black-neck."

tomatoes must not stand around for a sufficient length of time to permit the development of yeast, mold spores and bacteria. If the mold count is high, and the yeast spores, and bacteria low, then the material used was bad, but if the mold is low and yeast and bacteria are high then contamination started after peeling. If the tomatoes are held in a container until a sufficient batch has accumulated, the vessel should not be used unless scalded or steamed each time it is emptied, as the molds, yeast, and bacteria develop quickly along the seams and on the rough surface of the wood.

Formula for Chili Sauce

	Very Fine	Very Good*
Peeled tomatoes	5280 lbs. = 525 gals.	4320 lbs.
Sugar	360 lbs.	275 lbs.
Salt	80 lbs.	60 lbs.
Onions, peeled and chopped fine	100 lbs.	100 lbs.
Vinegar, 100 grain white distilled	160 lbs. or 18¾ gals.	160 lbs.
Garlic, peeled and chopped fine	8 ozs.	8 ozs.
Cayenne pepper	20 ozs.	20 ozs.
Mace	14 ozs.	
Cinnamon	36 ozs.	40 ozs.
Celery seed	36 ozs.	
Essential oils	6½ ozs.	6½ ozs.

Oil of Pimento, 1 pound; Oil of Clove, 2 pounds; Finish 280-290 gallons; Yield 310 gallons.

*To make this sauce hot add 4¼ pounds of yellow mustard seed in addition to the above spicing.

PROCEDURE:—Add about half of the tomatoes to the cooking tank and cover with about 100 pounds of sugar, then add about 350 pounds more of tomatoes, and turn on the steam, scatter the cayenne over the tomatoes and add the spice bag. As the batch cooks down gradually add more tomatoes so as not to stop the boiling and after all of the tomatoes have been added, and concentrated to about half the volume, add the balance of the sugar, and cook to below the finishing point. Then add the salt and finally the vinegar. The vinegar should be cooked in the batch several minutes to get rid of the raw flavor.

When finishing, the blended oil is scattered over the surface, steam is then turned on for about five seconds in order to mix. Then fill the bottles, at 190° F.

The peeling showed a 30% loss and each gallon of finished chili sauce required 18 pounds of peeled tomatoes.

Analysis of above formula:

Total solids	34.88%	30.84%
Total acidity	1.68%	....
Sugar	21.47%	20.34%
Salt	3.02%	2.70%
Ash	....	2.80%

Formula for Chili Sauce

Peeled tomatoes	130 gallons
Sugar	90 pounds
Salt	17 pounds
Peeled chopped onions	17 pounds
Red sweet peppers, fresh ground	37 pounds
Vinegar, 100 grain	6 gallons
Cassia, broken	2½ pounds
Cloves, headless	1½ pounds
Allspice	12½ ounces
White pepper	4 ounces
Jamaica ginger, ground	3 ounces

Cook to 60 gallons.

If desired the fresh sweet peppers can be omitted.

Tomato Paste: Per Cent Salt-free Solids, and Abbe Refractometer Reading.

Salt-free solids	Abbé refractometer reading at 20° C.	Salt-free solids	Abbé refractometer reading at 20° C.	Salt-free solids	Abbé refractometer reading at 20° C.
20.0	1.3614	24.0	1.3678	28.0	1.3743
20.1	1.3616	24.1	1.3680	28.1	1.3745
20.2	1.3617	24.2	1.3682	28.2	1.3746
20.3	1.3619	24.3	1.3683	28.3	1.3748
20.4	1.3620	24.4	1.3685	28.4	1.3750
20.5	1.3622	24.5	1.3686	28.5	1.3751
20.6	1.3623	24.6	1.3688	28.6	1.3753
20.7	1.3625	24.7	1.3690	28.7	1.3754
20.8	1.3627	24.8	1.3691	28.8	1.3756
20.9	1.3628	24.9	1.3693	28.9	1.3758
21.0	1.3630	25.0	1.3695	29.0	1.3759
21.1	1.3631	25.1	1.3696	29.1	1.3761
21.2	1.3633	25.2	1.3698	29.2	1.3762
21.3	1.3635	25.3	1.3699	29.3	1.3764
21.4	1.3636	25.4	1.3701	29.4	1.3766
21.5	1.3638	25.5	1.3703	29.5	1.3767
21.6	1.3639	25.6	1.3704	29.6	1.3769
21.7	1.3641	25.7	1.3706	29.7	1.3771
21.8	1.3643	25.8	1.3707	29.8	1.3772
21.9	1.3644	25.9	1.3709	29.9	1.3774
22.0	1.3646	26.0	1.3711	30.0	1.3775
22.1	1.3648	26.1	1.3712	30.1	1.3777
22.2	1.3649	26.2	1.3714	30.2	1.3779
22.3	1.3651	26.3	1.3716	30.3	1.3780
22.4	1.3652	26.4	1.3717	30.4	1.3782
22.5	1.3654	26.5	1.3719	30.5	1.3783
22.6	1.3656	26.6	1.3720	30.6	1.3785
22.7	1.3657	26.7	1.3722	30.7	1.3787
22.8	1.3659	26.8	1.3724	30.8	1.3788
22.9	1.3661	26.9	1.3725	30.9	1.3790
23.0	1.3662	27.0	1.3727	31.0	1.3792
23.1	1.3664	27.1	1.3728	31.1	1.3793
23.2	1.3665	27.2	1.3730	31.2	1.3795
23.3	1.3667	27.3	1.3732	31.3	1.3796
23.4	1.3669	27.4	1.3733	31.4	1.3798
23.5	1.3670	27.5	1.3735	31.5	1.3800
23.6	1.3672	27.6	1.3737	31.6	1.3801
23.7	1.3673	27.7	1.3738	31.7	1.3803
23.8	1.3675	27.8	1.3740	31.8	1.3805
23.9	1.3677	27.9	1.3741	31.9	1.3806
32.0	1.3808	33.0	1.3824	34.0	1.3840
32.1	1.3809	33.1	1.3826	34.1	1.3842
32.2	1.3811	33.2	1.3827	34.2	1.3843
32.3	1.3813	33.3	1.3829	34.3	1.3845
32.4	1.3814	33.4	1.3830	34.4	1.3847
32.5	1.3816	33.5	1.3832	34.5	1.3848
32.6	1.3817	33.6	1.3834	34.6	1.3850
32.7	1.3819	33.7	1.3835	34.7	1.3851
32.8	1.3821	33.8	1.3837	34.8	1.3853
32.9	1.3822	33.9	1.3839	34.9	1.3855
				35.0	1.3856

Corrections for Abbe Refractometer Readings when Determined at Temperatures other than 68° F. (20° C.).

Temperature °C.	°F.	Abbé refractometer reading 1.3400	1.3500	1.3600	1.3700	1.3800	1.3900	1.4000
		To be subtracted from reading:						
15	59.0	.0004	.0005	.0005	.0006	.0006	.0007	.0007
16	60.8	.0004	.0004	.0004	.0005	.0005	.0005	.0005
17	62.6	.0003	.0003	.0003	.0003	.0004	.0004	.0004
18	64.4	.0002	.0002	.0002	.0002	.0002	.0003	.0003
19	66.2	.0001	.0001	.0001	.0001	.0001	.0001	.0001
		To be added to reading:						
21	69.8	.0001	.0001	.0001	.0001	.0001	.0001	.0001
22	71.6	.0002	.0002	.0002	.0002	.0003	.0003	.0003
23	73.4	.0003	.0003	.0003	.0004	.0004	.0004	.0004
24	75.2	.0004	.0004	.0005	.0005	.0005	.0006	.0006
25	77.0	.0005	.0005	.0006	.0006	.0007	.0007	.0007
26	78.8	.0006	.0006	.0007	.0008	.0008	.0008	.0009
27	80.6	.0007	.0008	.0008	.0009	.0010	.0010	.0010
28	82.4	.0008	.0009	.0010	.0010	.0011	.0011	.0012
29	84.2	.0010	.0010	.0011	.0012	.0012	.0013	.0013
30	86.0	.0011	.0012	.0012	.0013	.0014	.0014	.0015

Corrections for Immersion Refractometer Readings of Tomato Pulp Filtrate When Determined at Temperatures Other Than 68° F. (20° C.).

Temperature °C.	°F.	Immersion refractometer reading 20	30	40	50	60	70
		To be subtracted from reading:					
15	59.0	1.05	1.12	1.19	1.26	1.34	1.41
16	60.8	0.86	0.91	0.97	1.03	1.09	1.15
17	62.6	0.66	0.70	0.74	0.78	0.82	0.86
17.5	63.5	0.56	0.59	0.62	0.66	0.69	0.72
18	64.4	0.45	0.48	0.50	0.53	0.55	0.58
19	66.2	0.23	0.24	0.25	0.27	0.28	0.29
		To be added to reading:					
21	69.8	0.24	0.25	0.26	0.28	0.29	0.30
22	71.6	0.49	0.51	0.53	0.56	0.58	0.60
23	73.4	0.75	0.78	0.81	0.85	0.88	0.91
24	75.2	1.01	1.05	1.09	1.14	1.18	1.22
25	77.0	1.28	1.33	1.38	1.43	1.48	1.54
26	78.8	1.56	1.62	1.69	1.75	1.82	1.88
27	80.6	1.85	1.92	2.00	2.07	2.15	2.22
28	82.4	2.15	2.23	2.32	2.40	2.49	2.57
29	84.2	2.45	2.54	2.64	2.73	2.83	2.92
30	86.0	2.75	2.86	2.97	3.08	3.18	3.29

Tomato Catsup: Per Cent Total Solids, Specific Gravity and Abbe Refractometer Reading.

Per cent total solids	Specific gravity at 68 F. (20 C.)	Abbé refractometer reading at 68 F. (20 C.)	Per cent total solids	Specific gravity at 68 F. (20 C.)	Abbé refractometer reading at 68 F. (20 C.)
16.0	1.067	1.3557	28.5	1.128	1.3767
16.5	1.069	1.3565	29.0	1.131	1.3775
17.0	1.072	1.3573	29.5	1.133	1.3784
17.5	1.074	1.3582	30.0	1.136	1.3793
18.0	1.077	1.3590	30.5	1.138	1.3802
18.5	1.079	1.3598	31.0	1.140	1.3811
19.0	1.082	1.3606	31.5	1.143	1.3820
19.5	1.084	1.3614	32.0	1.145	1.3829
20.0	1.087	1.3622	32.5	1.148	1.3838
20.5	1.089	1.3631	33.0	1.150	1.3847
21.0	1.091	1.3639	33.5	1.153	1.3856
21.5	1.094	1.3647	34.0	1.155	1.3865
22.0	1.096	1.3655	34.5	1.158	1.3874
22.5	1.099	1.3664	35.0	1.160	1.3883
23.0	1.101	1.3672	35.5	1.162	1.3893
23.5	1.104	1.3681	36.0	1.165	1.3902
24.0	1.106	1.3689	36.5	1.167	1.3911
24.5	1.109	1.3698	37.0	1.170	1.3920
25.0	1.111	1.3706	37.5	1.172	1.3930
25.5	1.113	1.3715	38.0	1.175	1.3939
26.0	1.116	1.3723	38.5	1.177	1.3949
26.5	1.118	1.3732	39.0	1.180	1.3958
27.0	1.121	1.3740	39.5	1.182	1.3968
27.5	1.123	1.3749	40.0	1.185	1.3978
28.0	1.126	1.3758			

Based on the examination of 24 samples of commercial catsups in 1934.

Based on Schoenrock's table for determining water in sugar solutions. The total solids given here are 1 per cent higher than those in Schoenrock's table, since the examination of several samples of commercial catsup indicates approximately that relationship.

Chapter IV—Canning of Specialties

BABY AND JUNIOR FOODS

BABY and junior foods are relatively new to the canning industry but the production of these commodities is increasing yearly. Baby foods are finely strained foods and junior foods are of the chopped style. Both styles of foods are produced from fruits, vegetables, meats, and mixtures of vegetables and meats.

The raw materials for baby and junior foods are usually selected for their excellent appearance and high vitamin content. Considerable care is exercised to retain the maximum amount of nutrients possible. This is usually accomplished by doing the preparation procedures in a minimum of water so that soluble nutrients are not drained away and also precooking procedures are under vacuum to minimize the destruction of vitamins.

Meat or Meat Products

Due to variations in formula and methods of preparation which may affect process relationships, these products should not be packed without directions from a research laboratory connected with the canning industry.

Recommended Processing Temperatures and Times*

Vegetables, chopped (Tin Containers)

Products	Dimensions	Initial temperature Deg. F.	Retort temperature Deg. F.	Time Min.
Beans, green	211x210	160	240	55
	211x214	160	240	55
Beets	211x210	160	240	40
	211x214	160	240	40
Carrots	211x210	160	240	40
	211x214	160	240	40
Spinach	211x210	160	240	60
	211x214	160	240	60

* From Bulletin 26-L, Processes for low acid foods in metal containers, National Canners Assoc.
From Bulletin 30-L, Processes for low acid foods in glass containers, National Canners Assoc.

Vegetables, strained (Tin Containers)

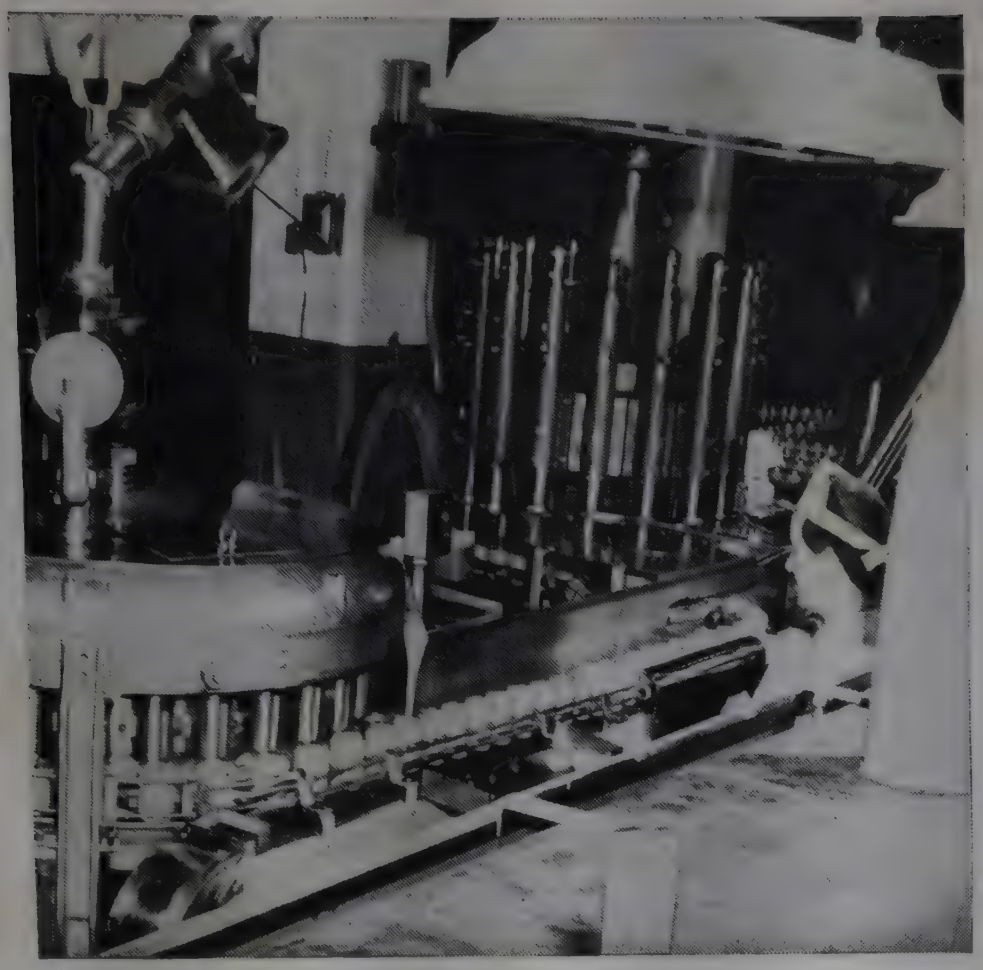
Products	Can name	Dimensions	Initial temperature Deg. F.	Retort temperature Deg. F.	Time Min.
Asparagus ...	Baby food	202x214	140	240	40
	No. 2	307x409	180	240	75
Beans, green..	Baby food	202x214	140	240	40
	No. 2	307x409	180	240	75
Beans, lima...	Baby food	202x214	140	240	50
	No. 2	307x409	180	240	90
Beets	Baby food	202x214	140	240	40
	No. 2	307x409	180	240	75
Carrots	Baby food	202x214	140	240	40
	No. 2	307x409	180	240	75
Peas	Baby food	202x214	140	240	50
	No. 2	307x409	180	240	90
Spinach	Baby food	202x214	140	240	45
	No. 2	307x409	180	240	75

Vegetables, strained (Glass Containers)

Products	Jar size	Dimensions	Initial temperature Deg. F.	Retort temperature Deg. F.	Time Min.
Beans, Green..	Baby	200x309	140	240	45
	Baby	200x309	140	245	40
	Baby	200x309	140	250	35
Beets	Baby	200x309	140	240	45
	Baby	200x309	140	245	40
	Baby	200x309	140	250	35
Carrots	Baby	200x309	140	240	50
	Baby	200x309	140	245	45
	Baby	200x309	140	250	40
Peas	Baby	200x309	140	240	60
	Baby	200x309	140	245	50
	Baby	200x309	140	250	45
Spinach	Baby	200x309	140	240	55
	Baby	200x309	140	245	45
	Baby	200x309	140	250	40

Left: Mechanical freestone peach pitter, operating in a baby food plant, has a normal capacity of 48 peaches per minute.

Right: Magnetic retort crate loader picks up baby food jars by their caps, fills retort crate at rate of 300 jars per minute.



Filler (left) and vacuum capper handling baby food jars 500 per minute. Extreme accuracy of fill and seal are necessary.

Vegetables, chopped (Glass Containers)

Products	Jar size	Dimensions	Initial temperature Deg. F.	Retort temperature Deg. F.	Time Min.
Beans, Green	Junior	208x401	150	240	55
	Junior	208x401	150	245	45
	Junior	208x401	150	250	40
Beets	Junior	208x401	150	240	50
	Junior	208x401	150	245	45
	Junior	208x401	150	250	40
Carrots	Junior	208x401	150	240	55
	Junior	208x401	150	245	50
	Junior	208x401	150	250	45
Spinach	Junior	208x401	150	240	75
	Junior	208x401	150	245	65
	Junior	208x401	150	250	55

BEANS WITH SAUCES

There are many styles of beans packed, each having a different flavored sauce that suits a certain trade.

For Pork and Beans, the beans used are those grown in Michigan and known as Michigan Pea Beans, a good grade grown in California is known as the Lady Washington. Both produce a fine pack, each having certain admirers. The Michigan beans contain more moisture than the California and usually require less time in processing.

Beans used for canning should be of the grade known as choice hand-picked and should be free from mold and anthracnose spots. All shipments received should be carefully examined to determine if they conform to the standards submitted in the sample or to a selling standard. Shipments not conforming are usually submitted to arbitration, both parties abiding by the decision of the referee. Some of the largest packers of pork and beans carefully pick and sort all of the beans received before soaking, consequently their product is exceptionally fine and uniform with no bad beans; others sort after soaking because the blemishes show up more prominently after soaking and hard beans also can easily be detected and removed. They should be passed through a fanning mill or "stoner" to remove any stones before being sorted.

Moldy beans may often be detected by smelling a double handful or by covering with boiling water and smelling immediately. A musty odor is indicative of moldy beans. This, of course, will produce a musty taste if canned. Moldy beans can be detected before or after canning by splitting the bean open and making a microscopic examination of the inner faces of the cotyledons. The mycelium of the mold is thus easily detected.

Anthracnose beans can be detected usually with the naked eye or with the aid of a hand lens.

Frosted beans can also be easily detected as they have a brownish color and produce an offensive odor when soaked and a bitter taste when canned.

A new system of mechanical sorting of beans has been devised using a photo-electric tube or electronic eye. The beans to be sorted are fed into a hopper attached to the machine. Under the hopper is a drum with a number of small apertures or openings around its circumference. A constant vacuum draws beans into each hole and as they pass on to the "electric eye" they are arranged mechanically for the proper position to pass before the sorter. The beans are sorted one by one and any bean showing the slightest defect or off color is immediately rejected. As long as perfect beans pass, the machine is unaffected but when a dark or defective one passes before the photo electric cell a relay operates and a metal finger deflects the bean which drops into a special container for them. As hand picked beans contain about 1½% defective beans which must be removed later, this electric system of sorting is far superior. The photo-electric cell detects only off-colored beans and does not sort to remove hard or otherwise defective beans that should be removed. It, therefore, has its limitations.

Freshly harvested beans high in moisture content are often packed by factories in close proximity to the supply as otherwise they would have to be dried and later soaked. On account of the tendency to mold and putrefy, beans with high moisture content must be used rapidly. Instead of soaking and blanching, as is the usual procedure, these beans may be cooked or blanched about 15 minutes, until soft, then used as they are soft enough without any soaking. Weather conditions due to heavy rains during the harvesting period may cause wet beans.

Atwater gives the following results on the dry Navy Bean:

Water-moisture	12.60%
Protein	22.50%
Fat	1.80%
Carbohydrates	59.60%
Ash	3.50%
	100.00%

COMPOSITION OF DRY BEANS—Calculated to Water Free Basis

(National Canner's Association—Bulletin No. 15)

Class of Beans	% Moisture	% Ash	% Protein	% Fat	% Crude Fiber	Carbohydrates	Calories per lb.
New York	22.89	4.17	27.28	1.54	4.38	62.63	1694
California	10.50	3.94	20.17	1.99	5.09	68.81	1696
California	10.50	4.11	23.54	16.3	5.74	64.98	1673
Michigan	21.45	4.21	28.53	1.44	4.47	61.35	1690
Michigan	25.04	4.05	26.23	1.38	5.04	63.30	1681
Michigan	24.62	4.02	28.37	1.26	4.27	62.08	1701

SOAKING:—Tanks used in soaking may be wood, galvanized iron, monel or glass lined. Glass lined equipment is ideal for soaking as wooden tanks easily mold, become contaminated and cause souring. As it requires from 12 to 16 hours to give beans the proper soaking, it is necessary to change the water several times especially in warm weather or in a warm climate, to prevent souring. In winter it may be necessary to slightly warm the water used in order to obtain

the maximum swell in the given time. If so, the water can be heated in the soaking tanks by means of steam lines. Heating after adding the beans has a tendency to over cook those nearest the steam pipes.

Beans that are low in moisture content and difficult to soften during the process can sometimes be softened by giving a preliminary blanching in hot water of about 180° F. for several minutes and then complete the soaking in the regular manner. If they remain very long in hot water they become too soft, split and their skins peel off.

As freshly soaked beans have a tendency to sour during the soaking period especially in warm weather, tanks should be equipped to permit a constant change of fresh water.

Beans may be soaked in any size tanks that are available as size and depth have no appreciable effect on the swell and the amount of water absorbed. To try this, place a weighed amount of beans in coarsely woven bags or screens, and place these bags at various depths of the soaking tank. At the expiration of the soaking period, weigh and compare the weights. Little or no difference will be obtained in the results.

WATER USED IN SOAKING:—Water has an important part in the final quality of the canned pork and beans. Beans to be of good quality should be firm and yet not hard, soft when eaten, but not "mushy." Often the bean itself may be the cause of the trouble, either too old, or hard, or mixed, i.e., of an old or new crop, and unless handled properly the canned product will not be of good quality.

Aside from the beans the water used has a great deal to do with the final quality of the finished goods. The harder the water used for soaking and blanching, the harder and firmer the finished beans. In order to overcome this hardness, hard water should be treated in a water-softening plant. An excessive alkalinity will cause the beans to disintegrate somewhat, becoming soft and "mushy." This condition cannot be determined until after the product has been sterilized.

Beans grown in certain localities possibly due to mixing or age or even different varieties may cause trouble during the soaking and processing. If old and new beans are mixed, there may be a marked difference in them after soaking. Some swell normally while others do not, resulting in beans of the normal swell being mixed with dry hard ones. Beans grown in an arid country mixed with normal ones may also give this result.

BLANCHING:—Should facilities not justify the installation of automatic blanching machinery it can be done by using wooden tanks or jacketed kettles. Place the beans in perforated buckets and submerge in hot water in the tanks and heat from 2 to 5 minutes, depending upon the age and softness.

A rotary blancher is more satisfactory.

After blanching, they may be sorted again to remove small stones, hulls, and split and defective ones before packing into the cans.

PORK:—Many use fresh or salted sweet jowl "buts", cut to the proper size whereas others use salted sides showing streaks of lean meat, as they prefer to have the pork show streaks of lean with the streaks of fat. The side meat will cut to better advantage—giving more uniform pieces than the pieces cut from the jowl.

STYLES OF PACKING:—Beans may be handled and packed various ways. They may be packed vegetarian style, i.e., no meat, only tomato sauce; plain pork and beans with no tomato sauce; pork and beans with tomato sauce; steam baked with pork and tomato sauce; steam and oven baked with tomato sauce and pork.

VEGETARIAN STYLE:—After the preliminary handling [illegible] and covered with any to- [illegible] determined by those who have certain religious and dietic scruples, the meat is omitted.

PLAIN SAUCE:—There are many who prefer a plain sauce as the tomato sauce may be too rich. The following sauce will produce a good plain bean:

Refiner's syrup	3 gallons
New Orleans molasses	1 gallon
Granulated sugar	55 pounds
Salt	34 pounds
Water to make	160 gallons

Have the sauce hot when added to the beans. The molasses and syrup may be varied according to flavor desired. Molasses with a strong taste or Refiner's syrup that is bitter should not be used. While some use a starch as a thickener in the plain sauce, it is not necessary because some of the beans are broken or disintegrated during the processing and enough starch is liberated to give the proper consistency to the sauce. If desired, use 10 pounds of starch to a 160-gallon batch. Mix the starch with sufficient cold water to make a thin solution and then add it to the sauce, boil until smooth and transparent before adding to the beans.

By blending the molasses, using one-half black strap with one-half Orleans, a slightly cheaper product may be obtained, but the flavor is not as good.

The following is another plain bean sauce:

Salt	85 pounds
Sugar	190 pounds
Caramel	5 to 6 pints
Corn syrup	236 pounds
Onions	36 pounds
Cider Vinegar (45-grain)	4 gallons
Celery seed	5 ounces
Parsley seed	7½ ounces
Water to make 600 gallons (hot)	

TOMATO SAUCE:—There are many different grades of this product depending upon the quality of sauce used. The following sauce makes a mildly flavored bean:

Tomato pulp, specific gravity 1.035	35 gallons
Sugar	75 pounds
Corn starch	8 pounds
Salt	34 pounds
Garlic—Ground (in a bag)	8 ounces
Vinegar (100-grain white)	10 pints
Cayenne pepper	5 ounces
Water to produce 160 gallons of sauce	

The sauce is made by heating water in the kettle, then adding the various ingredients. Boil slowly for about 5 minutes. As this sauce is not run through a finisher, it may be necessary to skim to remove any foreign matter that floats. The starch can be omitted, if desired, as the beans will thicken the sauce.

A better but more expensive sauce can be made according to the following formula:

Tomato pulp, specific gravity 1.035	40 gallons
or specific gravity 1.022	64 gallons
Allspice—whole	3 ounces
Cinnamon—broken and sifted	3½ ounces
Cloves—headless	3 ounces
Mace	2 ounces
Salt	15 pounds
Chopped onions	55 ounces
Ground garlic (in vinegar)	6¾ ounces
Sugar	46⅝ pounds
Vinegar (100 grain white)	[illegible] gallons

Cook all of the above ingredients to a thick sauce—reducing to about one-half the volume or 32 gallons in order to extract the flavor from the spice. This thick sauce can be stored in barrels (although one would not advise this practice, as it may turn black because of air, iron, and tannin) or in 5-gallon cans and processed 45 minutes at 212° F. When packed in cans reduce to about one-half the volume and omit the vinegar and salt, which can be added when used. This will give a better colored bean sauce, and less likelihood of pinholing.

This 32 gallons of thick sauce can be reduced with boiling water to produce 150 gallons of a finely flavored sauce. When used straight or with about 50% added water, it produces a rich sauce, but more expensive.

Another good tomato sauce formula for beans is as follows:

Tomato pulp, S. G. 1.040	24 5-gallon cans
Salt	77 pounds
Sugar	270 pounds
Corn Syrup	120 pounds
Chopped onions	28 pounds
Cider vinegar (45-grain)	4 gallons
Parsley seed	5 ounces
Celery seed	5 ounces
Bicarbonate of soda	6 ounces
Caramel	1 pint

Q. S. Water added to make 600 gallons hot.

In making bean sauce cover coils with water, add the onions, spice bag containing the celery and parsley and then add the pulp. Bring to a boil. Run in liquid made from corn syrup, vinegar, salt, sugar and about 70 gallons of water. Add soda, caramel, and water to 600 gallons. Bring to good boil before dropping. Run through finisher and keep agitated at all points where sauce is held.

OVEN BAKED BEANS:—In order to produce this product, it is necessary to first give the blanched beans a steam baking before subjecting them to dry heat. Unless given the steam bake first, which makes them soft and mealy, they would require too long a period of dry baking as they would not soften.

After steam baking, they can be passed through ovens on conveyors where they are subjected to dry heat from a gas flame for 50 minutes at 240-250° F., which further dries the beans and produces a "nutty" flavor. The baking temperature can be varied, as 250° F. may be too high for certain beans and cause them to brown or scorch too much, and if so, a temperature of 240° F. or even lower may be used.

After baking, the beans are filled into cans, hot sauce added, sealed, and processed in steam at 250° F. Some prefer processing at 240° F. as they believe the high temperature will not only affect the color of the sauce, but impart a bitter taste.

Tomato Sauce for Baked Beans—High Grade

Tomato pulp, specific gravity 1.022	150 gallons
White vinegar (100-grain)	3 gallons
Chopped onions (peeled)	1 gallon
Chopped garlic	1 pint
Sugar	110 pounds
Salt	35 pounds
Cinnamon	8 ounces
Cloves	7 ounces
Allspice	7 ounces
Cayenne	6 ounces
Mace	4 ounces

Cook this batch the same as for catsup and reduce the volume to 55 gallons. It can be stored in cans for future use, but not in barrels as there is too great a discoloration. When canned, omit the salt and vinegar until ready to use.

In using this sauce, add 12 gallons of hot water to 8 gallons of the concentrated sauce and heat it before adding to the beans. As this is a rich sauce, it can be further reduced if desired by the further addition of 10 gallons of water. A greater dilution than 1 gallon of concentrated sauce to 4 gallons of water is too much and will affect the taste.

PROCESSING:—After filling with hot sauce, the beans are run through an exhaust box, sealed and processed.

Size of Can	Time	Temperature F.	Time	Temperature F.
No. 1	60 to 75	240		250
No. 2	70 to 80	240	or 60	250
No. 3	85 to 90	240		
No. 10	120 to 150	240		
1 pound	75	240		

Michigan beans will often take less time in processing because they soften better during the soaking and blanching.

The meat used in packing pork and beans must be government inspected and usually the following amounts are used:

No. 1 can 6 ounces sauce and ½ ounce meat
No. 2 can 10 ounces sauce and 1 ounce meat
No. 3 can 18 ounces sauce and 1½ ounces meat

YIELDS:—A standard bag of beans weighs 165 pounds or 60 pounds per bushel.

The following are yields obtained in packing:

Size Can	Ounces blanched beans used per can	Cans per bushel of 60 pounds
No. 1 Sanitary	5 to 5½	334
1 pound	7¼ to 8	
No. 2	9¼ to 10½	480 to 520
No. 3 cap hole	15 to 15½	240 to 250
7-ounce can	3½	

Suggested Label Weights (Net Weight)

Beans, Oven-Baked (Sp. Gr. 1.10)		Lbs.	Ozs.
8Z Tall	211x304	.	9
No. 1 Picnic	211x400	.	11
No. 300	300x407	.	15½
Kitchenette	307x214	.	12
No. 95	307x400	1	1
No. 2	307x409	1	5
Jumbo	307x510	1	10
No. 2½	401x411	1	15
No. 10	603x700	6	14

Beans with Pork or Sauce (Sp. Gr. 1.10)		Lbs.	Ozs.
——	211x210	.	6½
8Z Short	211x300	.	7¾
8Z Tall	211x304	.	9
No. 1 Picnic	211x400	.	11
——	300x308	.	11½
No. 300	300x407	.	15½
No. 2	307x409	1	5
No. 2½	401x411	1	15
No. 3 Cylinder	404x700	3	3
No. 10	603x700	6	14

STEAM BAKED BEANS WITH TOMATO SAUCE:—To obtain a brown color, the blanched beans are placed in retorts under live steam, where they are browned before filling into cans, taking 50 minutes at 250° F. The blanched beans are placed on aluminum trays or racks in process baskets or else the baskets are lined with wire screen to prevent discoloration due to contact with the iron. This steam baking will give the beans a brown color. Some of

the commercial pack of beans labeled baked beans are handled this way, also the blanched beans may be packed in cans and processed at 250° F., which will brown them for good consumer appeal.

BOSTON BAKED BEANS

To many, there is only one "Baked Bean" and that is the "Boston Baked Bean." This delectable food has been made in New England for centuries and many a Saturday night meal or Sunday breakfast would not be complete without the beans and brown bread. The housewife prepared her beans and put them in her bean pot and took them to the nearest baker who placed the pots in his oven until properly baked. There has been a commercial demand for this type of food so that many companies are first baking and then processing the beans in either cans or glass.

In this process the beans are soaked over night, washed, blanched and placed in 2-quart bean pots (requires about 1 quart dry beans for each pot). It is better to add about one-half of the beans, then place a half-pound piece of salt pork containing a streak of fat and a streak of lean. The pork should be washed and cut or gashed across the top. Fill the pot with beans and to each pot add a brine made by using a teaspoon of salt, half a teaspoon of mustard, 2 tablespoons of molasses, all dissolved or mixed with hot water. Fill the pot with hot water. Bake slowly, some taking 6 hours. As the water evaporates, add more continuously until the beans are done when the water is cooked away. The beans are then either packed in glass or cans and a small piece of pork added and covered with a sauce made as above stated and given the usual process as outlined under Baked Beans.

METALLIC CONTAMINATION:—An off-flavor of canned beans may be caused by metallic contamination due to copper, iron, or zinc salts. A metallic flavor is due invariably to high iron or copper salts above the normal amounts. Copper salts from 1 to 6 parts per million may cause a slight discoloration in pork and beans with a slight bitter taste and a gray cast on the beans. This copper contamination may be due to too long cooking of tomato sauce in copper kettle, long standing during "shut downs" in filling machines or passing through brass pipe lines for great distances. Iron can be introduced through the pulp or some iron connections. Excessive amounts of metallic contamination may cause seizure and condemnation under the Federal and State laws.

KIDNEY BEANS:—These beans are soaked for 12 to 15 hours, changing the water several times, then blanched in boiling water 2 to 10 minutes, filled into cans and covered with a hot salt solution made by dissolving 50 pounds of salt in 400 gallons of water. Should a thick sauce be desired, add cornstarch at the rate of 5 pounds per 100 gallons salt brine. However, corn starch is not necessary to thicken. Another sauce can be made by using 10 to 14 pounds of salt with 10 to 18 pounds of sugar to 100 gallons of water. By using the plain sauce for pork and beans, a better product can be packed. If desired, pork can be added.

Process No. 1 can 60 minutes at 240° F.
Process No. 2 can 70 minutes at 240° F.
Process No. 3 can 85 minutes at 240° F.
Process No. 10 can 120 minutes at 240° F.

After processing, the cans should be well cooled. It is necessary in packing to see that there is sufficient sauce added to cover the beans. If this is not done, some of the beans will protrude above the top of the syrup and all such beans will become discolored either during sterilization period or later during storage. This discoloration is caused by the air in the head space of the can. "C"—enamel is superior to plain cans as it will prevent any discoloration due to head space or due to point of contact of the beans on the tin plate.

Suggested Label Weights (Net Weight)

Beans, Kidney (Sp. Gr. 1.08)		Lbs.	Ozs.
8Z Tall	211x304	.	8¾
No. 1 Picnic	211x400	.	11
No. 300	300x407	.	15
No. 1 Tall	301x411	1	.
No. 303	303x406	1	.
No. 2	307x409	1	4
No. 2½	401x411	1	14
No. 3 Cylinder	404x700	3	4
No. 10	603x700	6	12

Rotating rod washer separating broken and undersized black-eye peas from product for canning in a southern plant.

PINTO BEANS:—This bean, quite similar to the Red Kidney, is pinkish or "speckled" and has an excellent flavor when packed either with a plain bean sauce or with salt brine.

Handle the same as the kidney bean for soaking, blanching, exhausting, and processing.

SOYA BEANS:—In packing Soya beans, they should be soaked 12 to 14 hours and then cooked (boiled) until soft (which may require several hours), before filling into cans. Cover with plain sauce and process the same as other beans.

Some processors pack the beans in a tomato sauce and label them "Pork and Beans," which is misbranding.

Exhaust and process the same time and temperature used for pork and beans.

MEXICAN BEANS WITH CHILI PEPPER SAUCE:—The genuine Mexican bean is the best to use, but if not obtainable the red kidney bean may be substituted. Soak, and blanch, the same as the white beans, fill into cans and cover with the following hot sauce:

Tomatoes (peeled, not pulped) chopped fine	50 gallons
Peppers, fresh or salted or dry chili pepper	20 gallons
Ground Onions	20 gallons
Garlic (ground)	1 gallon
Salt	15 pounds

Add 25 gallons of water and boil for about 10 minutes. Add the hot sauce, exhaust, cap and process the same as for pork and beans.

JUICES

Unfermented juices such as apple, grape, pineapple, orange, loganberry, raspberry, and tomato, are the juices most commonly found on the grocer's shelves today. They may be bottled and sold plain or else carbonated before bottling. Sweet cider seems to be the only one that is sold as bulk in kegs and barrels while some of the other juices are canned and sold in No. 10 tins.

SELECTION OF THE RAW MATERIALS:—In making any fruit juice, the raw materials should be carefully selected so that the resulting product will have an attractive color and a good flavor that has not been destroyed or contaminated by the processes of handling or by bad raw material. Decayed apples or musty grapes will produce a product having an "off" odor and flavor. Highly colored and flavored fruits produce the best finished product.

WASHING AND SORTING:—Where the juices are being extracted on a commercial scale it is necessary to wash and sort to remove decayed materials, and yeast. Berries and other soft fruits can be washed as outlined under preserves, while apples can be handled through the tomato washing and sorting equipment.

CRUSHING:—Such soft fruits as berries do not need any crushing before extracting the juice, but they may be heated to break the cells and liberate the juice. Grapes are crushed and stemmed, while apples are "grated" or crushed to expose the cells and liberate the juice more freely.

CRUSHER:—The crusher used for grapes and other fruits consists of two corrugated or fluted cylinders, revolving toward each other. The fruit is fed to the crusher by means of a conveyor and hopper where it is carried downward between the rolls which compresses or crushes. In case of grapes, they are then passed to a perforated cylinder through which they are forced by a revolving paddle. The grapes fall through the perforations and the stems are forced through the other end.

APPLE GRATER:—Consists of a steel cylinder about 8 inches in diameter, having short knives full width of the drum, while parallel with the cylinder is a set of upright steel knives or blades toward which the cylinder revolves. The fruit passing between these rapidly revolving knives is grated or torn. The blades can be adjusted or removed to be replaced with new or sharp ones. Springs are attached to the knives which permit passing of hard objects such as bolts, or stones without damaging the blades. These blades are adjusted by using a dime as a gauge, for the distance they are set apart. Place the knives in the proper grooves of the cylinder, placing the dime on the face of the cylinder, and by means of the adjusting screw, set them until the edge of the knife comes flush with the top of the coin. It is also necessary to keep the knives sharp. When the graters are in continuous operation for 10 to 12 or even 24 hours, the blades should be replaced with sharp ones at least every two days. Have extra sets of knives so that one can be sharpened while the other set is in use.

As iron will discolor some fruits due to the reaction of tannin, iron and coloring, such metals as copper, brass, bronze, aluminum, or nickel alloy are used in the equipment, if possible.

PRESSING:—The juices of various fruits can be extracted by means of different kinds of presses namely:

SCREW PRESS:—This press is of simple construction, easily erected, without valves or plungers to keep packed or parts to freeze should the pressing be continued into freezing weather. The press is operated by levers and cogs, each being a separate unit.

HYDRAULIC PRESS:—While requiring less attention while operating, and giving a greater extraction of juice, it is attended with several objectionable features; namely, the freezing of the water or oil used in the drums and leaking of oil or water due to poor gaskets. An under pressure is better than an overhead pressure on this account. The liquid used in a hydraulic press is pumped under great pressure into the "ram" or cylinder which can be either raised or lowered according to whether it has an upward or downward pressure.

BASKET PRESS:—This type press is used in Europe and in the west for pressing grapes, being a cylindrical wooden basket or frame into which the crushed and stemmed fruit is placed.

BEAM PRESS:—This type is used more for home pressing or small factories that have very low production. Pressure is applied to the material by means of a long wooden beam with weights attached.

CONTINUOUS PRESS:—This press gives good service for certain class of fruits such as grape, but for softer ones such as berries it has a tendency to express too much pulp, thus making the product cloudy. The press consists of a cylindrical

Raw Product Supervisor and grower consult about progress of crop in the grower's vineyard in photo at left below. Right photo shows lug boxes of grapes being loaded onto a trolley conveyor which carries boxes, one at a time, to washing lines.

cone with a perforated bottom. The crushed fruit entering the hopper at the large end of the press is forced through the cone revolving within the cylinder to the smaller end. The expressed pulp or waste coming out automatically should be dry enough to burn.

PRESERVATION OF JUICES:—In order to keep indefinitely, the juices must be specially handled. This may be brought about by (1) heat applied directly to the product in tanks or kettles; (2) indirectly by subjecting the juices to heat after being bottled; (3) by low temperature freezing; (4) by means of chemical preservatives such as benzoate of soda or sulfur dioxide.

HEATING:—Heating to pasteurize the product is applied so as to destroy the activity of any organism that would cause spoilage. This expedient may only be a temporary means of preserving. Heat may be applied to the product in tanks or kettles to destroy the activity so that the product can be stored until such a time that it can be finished. As yeast which causes fermentation, is killed by heating to 145-150° F. the temperature of the juice very seldom is above 160° F. While mold requires a higher temperature of 175° F. for at least 20 minutes, there is little spoilage in the juices due to this organism.

Heating too long or too high produces a cooked taste and drives off a great deal of the delicate bouquet. The product can also be run through a series of jacketed pipes which contain steam or hot water heated to the proper temperature. The jacket should be automatically controlled so that a constant and uniform heat is applied. This method prevents contact with air and possible contamination, also prevents the escape of delicate aroma or flavor. Before the juice is permitted to pass through the continuous pasteurizer must be sterilized by very hot water.

REFRIGERATION:—The juices may be placed in cold storage and held at a low temperature until ready to be used, 32° F., is not low enough, 25° F. is much better. The juice as it comes from the press is treated with a filter aid and pumped through a plate and frame filter to remove any yeast before storing.

FREEZING:—Juices can be frozen then crushed and the ice separated from the fruit syrup. This syrup being heavy and concentrated will keep indefinitely after pasteurizing.

It is necessary to freeze this syrup twice in order to obtain the proper concentration. The syrup made by this process has all of the original fresh fruit flavor and aroma when diluted. While this method can be applied to other fruits, such is not the case commercially. The loss due to handling and double freezing in addition to the labor cost makes the price very high to sell on a competitive basis.

PRESERVATIVES:—Benzoate of Soda is commonly used to preserve cider; while sulfur dioxide is applied to grape juice, made from the European type of grape or the Eastern Catawba grape. This preservative in 1/10 of 1% is not sufficient to keep the product from fermenting, but will require from 15/100-2/10 of 1%. Benzoic acid has more antiseptic properties than sodium benzoate but is not soluble in fruit juices and is therefore not used as a preservative. Usually more than 0.1% is not used in the juices, but this amount can be increased if so stated on the label.

SULFUR DIOXIDE is used more in the West for the preservation of fruit juices, but is sometimes used in the East to aid in the preservation of Catawba grape juice. One-tenth of 1% sulfurous acid has greater antiseptic properties than benzoate of soda. It is often added in smaller amounts as a temporary preservative where the juice is to be settled and clarified before bottling. Small amounts often prevent the oxidation of the fresh juice which destroys the color and flavor. This preservative can be removed by heating the product to 160° F. and then passing air through it. The chief objection in the last is the after taste of the sulfurous acid.

Operator on platform is checking recording temperature instrument of grapes heating in the large hot-break kettle.

Apple Juice

In order to produce a good apple juice it is necessary that sound ripe apples thoroughly washed to remove dirt, yeast, spores, bacteria, and decayed parts, be used. Musty apples produce musty juice, cider or vinegar.

On account of the low cost, windfalls, culls, and run of the orchard are usually used. Some processors wash the fruit, while others do not think it necessary.

Apple juice is put up either as bulk in barrels and kegs or in No. 10 cans or bottles, the same juice being used but handled slightly differently.

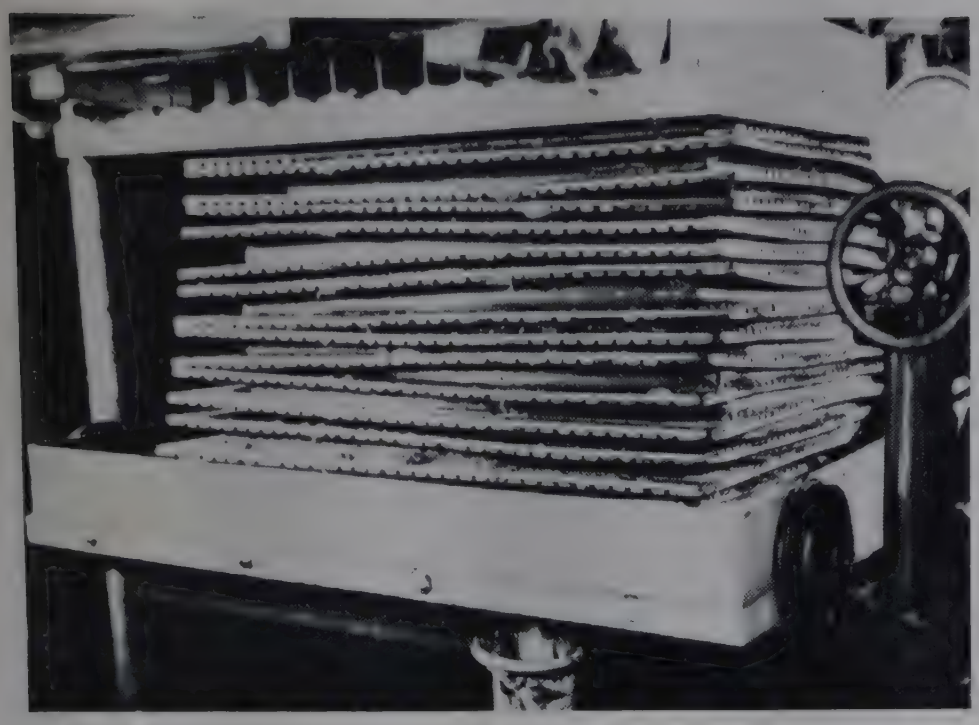
WASHING:—The fruit should be washed as it passes along a conveyor or through a rotary tomato washer. The tomato equipment can be used for both washing and sorting.

Since the best orchardists spray their trees to prevent disease, it is necessary to wash all apples. Soda solutions are not as effective as dilute acid solutions. After passing the fruit through the acid (1% hydrochloric acid) they are then washed thoroughly to remove the acid.

GRINDING:—In order to obtain the greatest possible yield, it is necessary that the apples be ground into a fine mass. This is done by using the apple grater, previously described. If they are ground too fine, are soft or frozen, they are hard to press. If too much iron and tannin is present, darkening will result.

PRESSING:—Hydraulic presses give the best juice yield—about 160 gallons per ton of apples.

Should an amber rather than a pale yellow color be desired in juice, it can be obtained by allowing the grated apples to stand exposed to the air in order to oxidize before pressing. Oxidation takes place quickly and the juice produced has a beautiful amber color. Often in building a cake of cheese a slight interim is allowed before the press-



Big hydraulic press squeezes juice from apples wrapped in cotton blankets and filters juice through wooden racks between.

cloth is folded into place and the next layer added. This gives a broader and thinner layer for oxidation to take place and the result is that the fruit colors much quicker and the glass packed juice appears much better to the customer than where the grated apples are permitted to oxidize in the grinding tank.

The length of time the grated apples are permitted to stand will not be long enough for fermentation to start and cause spoilage. Using two tanks for the grated apples so that one is being filled while the other is being emptied will also aid in controlling the color.

As ground apples do not slide readily through a sloping chute but pack easily the outlet of the tank should be directly over the place where the cheese is built.

No matter how careful the pressing is handled there is bound to be small pieces of apple in the cider. These may be strained by passing through gunny sacks, wire screens, or cheese cloth. Some use felt bags but they operate too slowly, though effective.

Frozen apples should not be used for apple juice under any condition as the resulting product will be very cloudy and not become clear upon standing. The cheese has a tendency to slip and slide in every direction when using frozen apples. Beside the great inconvenience while building the cheese, such apples are also annoying during the pressing operation. It is impossible to filter cloudy cider coming from frozen apples through ordinary filters, so that the cloudy juice can be used only to good advantage in making vinegar.

CLARIFICATION OF CIDER:—Until recently, cider was cleared with precipitants such as gelatine, lime salts and filtration with the aid of infusorial earths. A method of clarification has been developed using enzymes which decompose the soluble pectin in cider without affecting the starches or protein. It is during this decomposition of the pectin that insoluble substances are formed which can be easily removed by filtering as well as other substances which are responsible for the cloudiness or haziness of the cider. As a result of the experiments, a commercial product, known as Pectinol A, has been developed and used to produce a clear, sparkling cider. Another enzymanic product known as Clarase is also used for this clarification. It acts on the tannin and pectin substances in the juice. In using this product approximately 1% is used and mixed thoroughly to a thin paste with a small amount of juice and then well stirred into the larger quantity of juice. The juice is then agitated to assure uniformity of action. Cool, if possible, to below 40° F. for several days so that the enzyme can act properly. After clarification, the juice is drawn off and heated to 150° F. to stop further action of Clarase. Juice cleared by this means will remain clear after filtering. The juice can be sterilized at 170° F. for 20 minutes. Clarase acting on the tannin will bleach the juice somewhat to the same extent as when juice has been treated with gelatine.

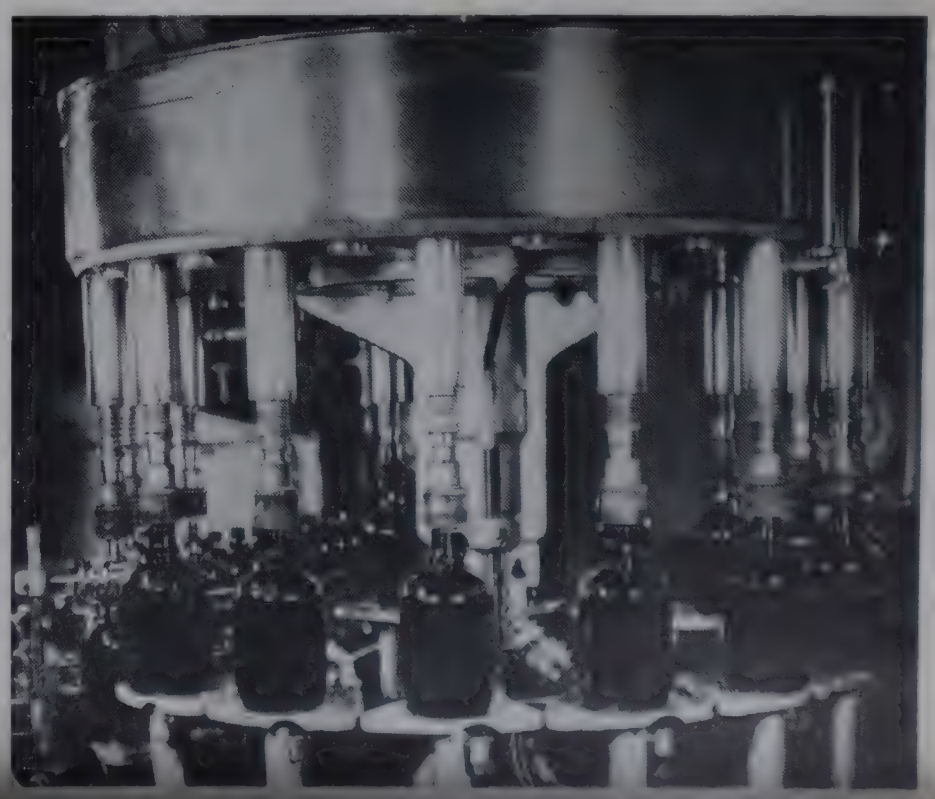
PECTINOL CLARIFICATION:—To 100 gallons of freshly pressed cider, add 1 pound of Pectinol A by sifting it into the juice. In some cases, the amount can be reduced depending upon the apples used. If possible, the juice should be warmed slightly because the warmer the liquid, the quicker the action. The juice should then be allowed to stand for from 4 to 5 hours or overnight if possible. The insoluble materials after the enzyme action are precipitated leaving a clear supernatant liquid that has the full rich flavor, with no undesirable foreign taste nor change in color or flavor. The juice can then be siphoned off and filtered if a sparkling product is desired. Bottle and pasteurize for 20 minutes at 170° F.

Gelatine and Tannin have been used to clarify cider, but it is necessary that the right amount is used to clarify the juice promptly and perfectly. It is necessary that a slight excess of tannin be present so that no excess of gelatine be present. A slight excess of tannin present is an asset in apple cider on account of the after-taste imparted but an excessive amount of tannin must be avoided. The usual procedure in handling these two clarifying agents is to make up definite stock solutions of both and add small amounts of each to small amounts of the juice. After the proper clarification point has been reached, then the proper amount of gelatine and tannin to be used can be calculated and added. After precipitation has occurred the juice can then be filtered. This method is not generally used for clarification since the Pectinol method has superseded it.

FILTRATION:—A great many manufacturers do not filter their juice for barrel stock rather the general tendency now is to produce a brilliant and sparkling juice. It can be filtered either hot or cold, by gravity or pressure.

FILTER AID:—Can be used as a filtering media packed either in commercial filters or a home-made one. If the product is heated first to 110° F. the working time of the filter can be almost doubled and produce a clear cider. Heating coagulates the protein and helps to break up the colloidal condition.

Sweet cider is shown being filled into glass jugs by automatic filler. Once filled, they move quickly to vacuum capper.



The juice can also be filtered by gravity or pressure through filter presses or any plate and frame press. On account of ease in handling and cleaning, the first two types are preferable. To obtain the best results, infusorial earth or "Super-Cel" is mixed with the juice before filtering in amounts varying from 0.10-2% depending upon the juice used.

"Super-Cel" will not impart an "earthy" taste to the cider coming from the press. It is preferable to have the parts of the press that come in contact with the cider of a metal other than iron, as small amounts of iron will often cause the product to darken. The action of the iron from the press, the tannin in the apples or in the cork (when the juice is bottled) and the oxygen from the air cause a chemical change to take place which causes the darkening.

The iron parts of the press are often coated with some acid proof paint while others paraffine the parts. Before applying paraffine the press is steamed thoroughly to clean and heat the metal and while hot a block of paraffine (free from carbon oil) is rubbed over the different parts and melted with a blow torch. This gives the parts a thin coating of paraffine which makes it acid proof. This coating must be renewed from time to time. Some prefer brass, nickel alloy metal or wooden parts.

BULK JUICE:—In order to keep bulk juice from fermenting a preservative must be used such as benzoate of soda or sulfur dioxide. The latter imparts a sulfurous acid taste to the product which is objectionable to many; benzoate of soda is preferable. One-tenth of 1% benzoate will not preserve the liquid indefinitely. However, powdered mustard used in conjunction with benzoate of soda will help preservation. Less than 0.1% of each may be used effectively. The addition of mustard imparts a slight "biting" taste similar to that produced by carbonating and is not objectionable but rather improves the flavor.

Four ounces each of powdered mustard and benzoate are sufficient to preserve 50 gallons of juice. In using, it is better to mix the powders together and add about a pint of juice and mix to a smooth consistency before adding to a 50-gallon barrel. Bung and roll in order to mix. It requires 6½ to 6¾ ounces of benzoate per 50-gallon barrel of juice.

These preservatives may be mixed in large amounts with juice and an aliquot part taken. This saves considerable time especially when large quantities are being used.

Juice may be treated in large tanks with these preservatives. After thoroughly mixing, allow it to stand until the mustard settles, before filling into barrels. After standing several days the juice may be filtered mechanically to insure a clear product and then barrelled. The volatile oil of the mustard is liberated when moistened with the juice and aids in preserving. Volatile oil of mustard in very small amounts has a wonderful preservative power.

Be careful of the benzoate used as some grades have not been purified sufficiently and will impart a decided offensive taste to the product.

BOTTLING AND PASTEURIZING:—Bottled juice should be brilliant and clear. After straining, it is treated with about 0.10-2% diatomaceous silica (about 300 pounds per 5,000 gallons). After filtering it is heated before filling, then capped and pasteurized. Filter before filling as an extra precaution to remove any yeast and finely suspended marc or pomace. Carbonating gives the product a more desirable taste and makes it more palatable. The juice is heated to 100° F. before filling and then pasteurized at 160° F. for 30 minutes. The lower the temperature used in handling, the better the flavor as heating too high or too often will produce a cooked taste with loss of bouquet. Some prefer heating the product only once, that is, when they pasteurize, but care must be taken to prevent excessive breakage when pasteurizing the cold products.

One essential feature of pasteurization is the after cooling. Enough attention has not been given this important phase of the handling. The heat which is retained for some time in the bottles will cause the product to lose flavor and have a cooked taste. The bottles should be cold when coming out of the pasteurizer or else chilled. When carbonating, 15 to 20 pounds pressure gives good results.

STORING OF JUICE:—Unpreserved juice may be held in glass lined tanks in cold storage at about 25-28° F. until needed. Examine at different intervals for fermentation and upon the slightest indication such juices should be rehandled. Before storing, the juice is filtered to remove any yeast that might be present. The tank must be perfectly clean before using. If the product is to be carbonated, this may be done in large glass lined tanks under 30 pounds pressure. Carbonating improves the flavor and gives it a little more "snap."

Juice can be stored in barrels by using preservatives or in 5-gallon jugs or carboys the same as grape juice. After pressing, it is heated in kettles until the temperature is not over 160° F. Skim to remove any pulp, small pieces of apples and foam. Fill into 5-gallon carboys or jugs that have been previously washed thoroughly and steamed until extremely hot. Cork and stack in tiers or shelves. Storing permits finely divided particles or suspended matter to settle. The time required to settle varies but usually several months will elapse from the time of filling until using. When sufficiently clear it is then siphoned or racked carefully so as not to disturb the sediment. The dregs may be emptied and fermented for vinegar or it may be strained, reheated, jagged, and stacked for resettling; however, the more cider is heated and handled the poorer the flavor. Some prefer to heat the juice to about 100° F. just before bottling and others fill cold and pasteurize to retain the original fresh apple flavor. Bulk storage under refrigeration should be given consideration. The number of persons required to handle by this method are fewer. Rapidity with which large quantities can be taken care of in addition to the reduced loss of the product and containers by breakage are factors that are worth considering.

The lower the temperature at which the product is handled and the length of heating time influence flavor greatly. Some

First step in making grape juice is to clean all fruit thoroughly. Here women carefully cull imperfect fruit as it passes by.

Prior to inspection, grapes pass over vibrating screen and under strong water spray. This unit was developed by processor.

processors heat the product as low as 140° F. without any special loss but they have undoubtedly used select stock, carefully washed and sorted. Between 140-150° F. is the thermal death point of yeast and any lower temperature is dangerous. If care is used in handling cider in the kettle, it may be run in and out, while being heated and skimmed.

Juice from carboys that is to be bottled after being siphoned, can be pumped to the top floor of the plant where it is handled by gravity. If possible, it should be filtered. All pump lines used should be thoroughly cleansed by hot water before and after pumping.

If the juice is heated to about 100-110° F. and skimmed before filtering, it coagulates the protein and the filter may be operated much longer before cleaning. The bottled juice is capped and pasteurized at 160° F. for 30 minutes.

More attention should be given to the storage cellars where the jugs and carboys are stacked. Due to poor circulation of air, the heat is retained in the center of the stack of bottles for weeks and this heat is bound to react on the color and flavor.

All press cloths used should be thoroughly washed and aired each day with extra sets of cloths on hand so that this can be accomplished.

The pomace coming from the press after being broken apart, can be dried until it contains 8-10% moisture, then stacked and used for pectin jelly.

One ton of apples will yield 160-170 gallons of juice at the first pressing with an additional yield of 20 gallons at second pressing for vinegar stock. One ton also produces 470 pounds of wet pomace or 128 pounds of dried with a moisture content of about 10%. An analysis of apple pomace is given under jelly.

CONCENTRATED CIDER:—In addition to the freezing method, cider may be concentrated in vacuum pans or in continuous evaporators.

Boiled ciders are concentrated 4 to 1.

Concentrated ciders are reduced 5 to 1.

Cider jelly is concentrated 7 to 1.

A continuous evaporator consists of a wooden box varying in length from 12 to 20 feet, divided almost the full length into two compartments. The cider flowing down one side and back the other is concentrated as it passes over brass or aluminum pipes. Usually the bottom of the box is lined with six ¾ inch pipes and the steam so regulated that the product is concentrated to the proper density when it reaches the end. At the starting point a small space is partitioned off where the impurities are removed. This compartment also contains a float which regulates the feed. An angle thermometer is attached to the draw-off end of the box. When starting the evaporator, feed enough cider to cover the pipes and then turn on the steam and when the cider in the evaporator comes to a boil open the feed valve. As most of the concentrated cider is sold according to Baumé test, this instrument is used. When it tests 24-26° hot it will have the proper density when cold. The temperature should be from 215-216° F. for boiled cider to test 20-32° Bé hot or 218-220° F. for cider jelly.

The following are analyses of concentrated cider:

Concentrated Cider

Solids	64.41%	66.85%	69.13%
Fixed Acid (Malic)	3.183%	2.51%	2.178%
Total Acid (Acetic)	3.90%	2.70%	2.40%
Volatile (Acetic)	1.05%	0.45%	0.45%
Specific Gravity at 15.6° C.=	1.311	1.316	
or 10.9 pounds per gallon	10.96 pounds per gallon		

Grape Juice

Grape juice is the unfermented product of the expressed juice of grapes. In the eastern part of the United States, one immediately associates it with the product made from the Concord grape. The Labrusca varieties are used in the east, the Vinifera varieties are used in the west, while in the south Muscadine varieties are used.

Grapes contain from 12-38% sugar besides protein and varying amounts of acid, tannin, cream of tarter, fat, starch, and coloring matter.

The Labrusca varieties are noted for the high color, acidity, and "foxy" flavor while many of the Vinifera varieties are devoid of any characteristic flavor and are low in acid but blend well with Labrusca varieties. Muscadine varieties are also devoid of fine flavor and aroma.

QUALITY USED:—The grapes used are of the highest quality obtainable. The berries must be large, firm, fully developed and ripe; no green or red fruit is used. Processors must maintain a close supervision over the purchased fruit and any violation should result in cancellation of the growers' contract. As the growers usually receive a bonus on the quality delivered to the manufacturer, he does not care to have his contract cancelled. Usually a warning is sufficient.

It does not necessarily follow that by using choice fruit the resulting product will be of the highest character. Mishandling can spoil the best of raw materials.

Grapes for factory use are packed in lug boxes, each holding about 30 to 50 pounds. The boxes are packed level so that the fruit does not become crushed or mashed during handling. Deliveries are made direct to the plants or else transported in refrigerator cars with open ventilators to allow air circulation.

It is advisable to allow the grapes to stand at least 24 to 36 hours before pressing in order that they mellow and increase in bouquet (aroma). The boxes are so stacked in a

cool ventilated place so as to permit the circulation of air and prevent heating and spoiling.

WASHING:—As grapes are grown on vines high above the ground, it is not customary to wash before pressing unless they have been sprayed with insecticides or fungicides. If fermentation or molding has started, they should be washed and sorted to remove all fruit in such condition. There is a difference of opinion as to whether washing removes some of the delicate flavor thus making them insipid, but as the fruit is only subjected to water for a short period, the flavor is hardly affected. Washing also introduces water, thereby diluting the product slightly.

Compressed air as a means of cleansing seems to remove the dust, etc., can be applied to the fruit as it passes along a conveyor belt. Any efficient fruit washer that is available may be used. The Government is recommending that all grapes used in making juice be washed to remove all extraneous matter.

CRUSHING AND STEMMING:—Bunches of grapes are run through a crusher to flatten the berries and break them from the stems, then through the stemmer which gently knocks off the berries. Stems containing tannin and a small amount of cream of tarter will impart an astringent taste to the juice unless removed.

PRECOOKING:—After being stemmed the fruit is run into aluminum kettles. Aluminum is used throughout the system because there seems to be very little action of the tartaric acid or tartrates upon this metal, and no preceptible flavor or discoloration.

The fruit is heated to 140-145° F. while being agitated continually either mechanically or else by hand paddles. This stirring while heating aids in extracting the coloring matter from the skin, breaks fruit apart and produces greater yield.

While running out of the kettle, the fruit is stirred vigorously so that the pulp and juice do not separate as a separation sometimes makes the pulp difficult to remove.

Some heat the crushed fruit in shallow jacketed troughs either by steam or hot water and agitate them mechanically by means of a helicord paddle.

A thermometer is not always used to determine the proper degree of heating, but it is more reliable; the fruit may be heated until the pulp has assumed a pink color throughout.

The heated mass is then dropped by gravity to supply tanks equipped with agitators situated over the place where the cheese or layer of grapes is to be built prior to pressing. Some run the heated grapes directly from the kettles to the press racks.

PRESSING:—While some use screw presses others prefer a hydraulic with 170 tons pressure to obtain a greater yield. It requires about one hour to make the proper extraction, but if not rushed the cheese may be left under the press for a longer period. The extracted juice will contain small particles of grape no matter how carefully handled, consequently it must be removed by straining. Some use cheese-cloth bags or wire screens.

The juice from the presses should next be run into a large blending tank or reservoir directly under the presses situated above the final heating kettle. This insures a more uniform mix of the juices from the various presses, resulting in a more uniform flavor and color. While the warm juice has an appetizing odor, yet the taste is sour and astringent. To determine the chemical difference in the juice coming from the same press at different periods during the pressing, samples were taken at about five-minute intervals, sealed, pasteurized and allowed to remain undisturbed for about six months for the argol (crude cream of tartar) to settle, after which they were analyzed. The results obtained (see table) show that as the sugar decreases the acidity increases.

The juice is next heated in aluminum kettles to 160° F., skimmed to remove foam, particles of skin, pulp, etc., and then filled into five-gallon glass carboys or earthenware jugs. After closing with paraffined corks and stacked in tiers or shelves, the bottles are allowed to remain undisturbed for several months in order that the argol (crude cream of tartar) separates.

Before filling the bottles they must be thoroughly washed with hot water and steamed or placed in a steam chest for about 20 minutes. Always fill the carboys hot and cork immediately.

There is a great deal of breakage due to washing, steaming, filling, and corking of the five-gallon bottles or jugs. Some breakage could be avoided if the bottles were tested by means of compressed air or suction the same as five-gallon cans are tested; thus imperfect or defective bottles could be quickly detected.

STORAGE IN BOTTLES:—While many manufacturers use glass bottles for storage the earthen jugs are preferable because the product is not exposed to the light and a better flavor and color result.

Juice Analyses From Same Press At Different Time, Same Grape Variety

Sample Number	Time Taken P.M.	Specific Gravity	Alcohol by Volume	Total Tartaric Acid	Total Acid (Tartaric)	Ash	Degrees Brix	Solids by Evaporation	Total Sugar (Invert)
1	1:07	1.080	0.07	0.84	0.87	0.308	19.3	20.447	17.19
2	1:10	1.081	0.2	....	0.833	0.32	19.5	20.50	17.275
3	1:15	1.0788	0.07	0.773	0.833	0.276	19.3	20.907	17.01
4	1:20	1.0788	...	0.788	0.859	0.284	19.3	20.13	16.93
5	1:25	1.0785	0.2	0.831	0.885	0.276	19.0	19.727	16.72
6	1:30	1.0785	0.2	0.788	0.885	0.245	19.1	19.682	16.57
7	1:35	1.0780	0.2	0.788	0.885	0.244	19.0	19.832	16.115
8	1:40	1.0775	0.07	0.737	0.889	0.262	18.8	20.15	16.135
9	1:55	1.0777	0.26	0.773	0.975	0.284	18.75	19.633	15.53
10	2:00	1.0778	0.2	0.833	1.088	0.264	18.8	19.75	15.915
11	2:05	.....	0.2	0.833	1.088	0.250	...	20.00	15.89
12	2:10	1.0777	0.2	0.836	1.10	0.24	18.7	20.11	15.89
[illegible]	2:15	1.076	0.07	0.785	1.05	0.222	18.5	19.397	15.555
[illegible]	[illegible]:20	1.076	0.07	0.773	1.06	0.212	18.6	19.502	15.99
[illegible]	[illegible]	1.0774	0.07	0.743	1.065	0.325	18.7	19.777	15.79
[illegible]	[illegible]	1.077	0.07	0.735	1.068	0.232	18.7	19.33	15.445
[illegible]	[illegible]	1.076	0.07	0.743	1.065	0.24	18.4	19.03	16.57
[illegible]	[illegible]	1.076	0.2	0.743	1.073	0.245	18.6	19.18	16.05
[illegible]	[illegible]	[illegible]	[illegible]	0.735	1.073	0.245	18.6	19.06	15.705
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	18.6	[illegible]	[illegible]

Here is an important step in building a cheese for juice press. Operator is folding the blanket over the form holding pulp.

Rolling a 14-layer cheese under a juice press in grape juice processing plant. Proper extraction requires one hour.

STORAGE OR STACKING:—The cellar or storage room is always kept dark, as the light seems to bleach the purple color and leave it red. Two samples of juice from the same kettle stored in glass and jug show a marked difference as the latter revealed a better color and flavor. One of the objections to the jug is that the layer of argol on the bottom cannot be seen and the quality of the product endangered by siphoning too close. Another objection is purely sanitary, claiming that it is impossible to tell when the jugs are clean. Should the empty jugs be handled properly, there should be no danger from unclean ones.

It is customary to stack the carboys of juice in compact tiers as high as the ceiling. No special thought being given as to facilities for cooling. As the juice is quite hot when stacked, it naturally retains the heat for some time; the center of the stack will be like a fireless cooker and retain the heat for a greater period than those on the outside of the pile. One can apply the same term as is applied to canned foods. The juice will "stack burn."

Some arrangement should be made to cool the carboys before stacking, either by passing them carefully through water so as to avoid breakage or else by spraying. They could be cooled by being passed gradually into cooling rooms where they can be stacked and kept at 30-32° F. until cool. Some cool their cellars by suction fans which remove the hot air, but this method is not very satisfactory. The lower the temperature at which the carboys are cooled and stored the less danger of fermentation and the more rapidly the juice will clear and deposit the argol, giving a superior product both as to flavor and color.

After juice has been pressed, these blankets are being cleaned in laundry washer and spun dry for further use.

BULK STORAGE:—Almost all of the larger producers of grape juice store their product in carboys or jugs, but there is no reason why it cannot be stored in clean glass-lined tanks under refrigeration. Should this be done a better product could be obtained in a shorter period than is required under present methods employed.

When the product is to be handled in bulk it should be heated to about 160° F. and then run into glass tanks that have been previously washed and steamed. The fruit can be heated to 140° F. to extract the color and flavor after which it is pressed, filtered and stored at 28° F. This temperature will freeze the juice and cause a rapid formation of cream of tartar. Upon thawing, it can then be heated and bottled or it can be heated, filtered, and bottled. The removal of the tartrate improves the flavor. Stored under these conditions the product must be examined from time to time for any sign of fermentation. A draw-off about six inches above the bottom should be used so as not to disturb the sediment of argol after which the juice remaining in the bottom is drained and separated to obtain the argol and juice.

If the juice is to be stored in barrels, see that they have been washed and steamed until very hot before filling. Close immediately with bungs and cloths that have been sterilized. Place the barrels in a cold place at 30-32° F. on racks or skids with bung up. As barrels often contain dust holes which permit air to be drawn into the product during the cooling, painting the outside may prevent it.

It is customary to hold a reserve stock of the old juice for bottling so that the argol in the new juice will have time to settle. In the fall as the grapes are received, the energy of

Here a plate type pasteurizer is being used to prepare the grape juice. The procedures are similar for other juices.

the entire force is devoted to immediately handling the grapes in order to prevent spoilage, consequently there is an interim of about three months in the bottling.

After standing at least three months the argol has invariably settled so that the juice can be siphoned for bottling. The juice and residue in the bottom of the jugs is called lees. This is dumped into a sloping bottom tank with a strainer at the lowest point so that the juice can be drained from the argol. The strained juice may be reheated to 160-170° F., refilled into carboys and again allowed to settle before it is blended with other juice. The heavy crystals of argol will settle and can be removed and dried. This by-product is used in making tartaric acid and cream of tartar and is well worth recovering because of the price one can obtain.

Analysis of Samples of Argol

	No. 1 Per cent	No. 2 Per cent
Moisture	1.276	0.79
Solids	98.724	99.21
Total sugar (invert)	2.432	1.07
Potassium bitartrate	86.010	88.36
Tartaric acid	10.282	9.78

BOTTLING:—After siphoning the juice from the carboys it is pumped to aluminum kettles where it is heated to 160° F. before being filled. It has been the general practice to add 2% sugar to the juice (one pound of sugar to five gallons of juice). The addition of sugar in the form of a syrup is considered adulteration unless properly labeled because the syrup contains moisture.

The general procedure for filtering, bottling, capping, and pasteurizing is the same as for apple juice.

Grape pomace is discussed under grape jelly showing an analysis and the utilization of this waste product.

The following is an analysis of Catawba Grape Juice:

Total solids	19.845%
Ash	0.275%
Total acidity (tartaric)	0.997%
Alcohol by volume	0.200%
Potassium (bitartrate)	0.282%
Total sugar (reducing)	14.525%
Sulfur Dioxide SO2	0.035%
	0.035%

The following table shows analysis of samples of commercial grape juice:

	1	2	3	4	5	6
Total solids (brix)	22.3	19.9	19.2	18.0	18.0	18.2
Total acidity (tartaric)	1.005	0.81	0.9	0.735	0.975	0.89
Alcohol by volume	0.118	0.07	0.52	0.26	0.26	0.51
Total sugar (as invert)	19.43	18.04	17.35	15.68	15.17	....

GRAPE SYRUP:—This concentrate can be made by two methods; either concentrate the juice to the desired consistency in vacuum or else by freezing.

Open kettles should not be used because the high temperature used in concentrating carmelizes the sugar producing an off taste and color. Copper kettles, if used, will also affect the color and flavor.

In using the vacuum process, the higher the vacuum the lower the cooking temperatures, resulting in a superior color, flavor, and odor (bouquet or aroma). The vacuum should be at least 27 inches and the temperature should not exceed 130° F.

The syrup may be concentrated from 60-70° Brix. The higher the concentration the better the keeping qualities, but of course with less yield and poorer flavor. If the grape juice is held at 20° F. before concentrating, separation from the cream of tartar is effected thereby producing a better flavored product.

The freezing method and separating the juice from the ice produces a product with all the delicate flavor and bouquet without the harsh taste of the cream of tartar.

The following is an anlysis of concentrated grape juice:

Total solids	59.730%
Total acidity tartaric	1.575%
Total tartaric acid	1.215%
Potassium Bitartrate (Cream of Tartar)	0.244%
Total sugar (as invert)	53.160%
Non sugar solids	6.570%
Ash	0.140%
Specific Gravity	1.215%

The syrup can be filled into bottles or cans but must be

Bottled grape juice leaves continuous pasteurizer-cooler in background, having received sprays at three temperatures.

Here an automatic four-row case packer handles 340 containers per minute, operated by one man. Steel fingers fill each case.

pasteurized for safety although syrups containing 65-70° Brix may keep with safety. Pasteurize at 170° F. for 30 minutes.

Some very interesting and very helpful, as well as extensive experiments have been conducted on grape juice by Drs. Tressler and Pederson, and published in "Food Research," January and February, 1936, Vol. 1, No. 1. The conclusions which they have reached are quoted verbatim for the benefit of those who may not be able to secure this pamphlet.

1. "Pasteurized Concord grape juice stored under a high vacuum or in bottles containing substantially no oxygen undergoes very little change even when exposed to light at room temperature.

2. "The juice in partially filled bottles deteriorates rapidly. The changes noted are the clouding of the juice, a change from bright purple red to a brown color, a slow deposition of a brown sediment leaving an amber colored juice, and a detrimental change in aroma and flavor. These changes occur more rapidly at room temperatures than at lower temperatures. Light, particularly that of short wave length, accelerates these changes.

3. "Commercially bottled grape juice has been subject to the oxidative changes described above since the air has not been eliminated from the bottle.

4. "Concord grape juice which has never been heated does not keep well even though it is sterile and kept in absence of oxygen.

5. "Concord grape juice seems to keep equally well in soft glass, hard (resistance) glass, and pyrex glass containers.

6. "Heating at 73.9° C. (165° F.) for 30 minutes is sufficient to destroy the microorganisms in the juice, so that it will keep satisfactorily in bottles containing little or no oxygen in the head space."

The bottlers of grape juice can pack an improved product by carrying out the above suggestions. For filled bottles that are to be shipped, processors can apply a low vacuum to the warm juice, but care must be exercised that the juice is not drawn out of the bottle. They can blow steam into the top of the bottle to expel the air but be careful not to blow out the juice or have condensed steam fall into the bottle. They can also have a jet blowing carbon dioxide or nitrogen gas into the bottle so that the air is replaced just as the bottle is being capped.

If it were not for great loss due to expansion and contraction, and danger of the bottles bursting during pasteurization and cooling, the easiest method would be to fill the bottles to the top and not leave "head space." However, such a fill is apt to cause leaks around the crowns.

PINEAPPLE JUICE:—Unless handled on a commercial scale, the canning of pineapple juice will not pay. It deteriorates after being packed and loses the delicate pineapple odor and flavor. It may be used for making sherbets or soda fountain syrup.

The juice from the trimmings of the fruit is treated to remove albuminous matter, pulp, etc. Unless this albuminous matter is removed, it forms a milky precipitate or sediment in the bottom of the container.

Clarification is accomplished by heating with a small amount of milk of lime. This coagulates the albumin and causes a precipitation of the suspended matter after which the juice can be filtered and concentrated. The addition of sugar to the juice improves the flavor.

PRUNE JUICE:—Bulletin 483 published by University of California Agricultural Experimental Station, Berkeley, Calif., and written by Mrak and Cruess describes a process for making prune juice, which is herewith given:

"The prunes are first soaked in water at 200-212° F. for about 5 hours and then drained. The operation was then repeated a second, third and fourth time, with fresh water. The different lots of juice so obtained were combined and filtered through a pulp filter. The juice was then bottled and pasteurized at 175° F. for 30 minutes. Juice of about 20° Brix pleased the average consumer best.

"The sugar and juice remaining in the leached prunes was found insufficient in amount to warrant pressing. In some experiments prunes were boiled and pressed, but the juice was so cloudy and gummy that it could not be filtered. In commercial practice the diffusion battery principle could be utilized. In a typical leaching test in which three leachings were used the following results were obtained:

"Weight of prunes used 50 pounds.

"Volume of water used in consecutive soaking 12, 7, and 5 gallons.

"Time of soaking for each application, 3 hours; total 9 hours.

"Concentration of juice from first leaching, 13° Balling.

"Concentration of juice from second leaching, 24° Balling.

"Concentration of juice from third leaching, 22° Balling.

"Average concentration of all leaching, 19.25° Balling.

"Total volume of juice obtained after filtration, 14 gallons or 560 gallons to the ton of prunes. If desired, lemon juice may be added before bottling or at the time of serving."

Considerable research as to time and temperature necessary to successfully pasteurize prune juice has been done. It has been found that a processing temperature of 160-170° F. is insufficient and that if a processing temperature of 180° F. is used it will require 50 minutes, of which 25 minutes are required for proper heat penetration. If the temperature is increased to 190° F., then the time can be reduced to 35 minutes. If the bottles could be agitated, then the time can be reduced to 28 minutes. This time and temperature applies to quart containers, which are the size used for packing prune juice.

ORANGE AND LEMON JUICES:—This juice can be obtained by grinding the fruit, pressing, then separating the oil by centrifuges, and concentrating under a high vacuum of 28 inches so as to retain the flavor. A much lower vacuum automatically raises the temperature considerably and causes

Oranges being dumped from truck into bucket elevator, which carries them to sorting and washing operations. Fruit must be thoroughly washed to remove dirt, dust, mold spores and smut.

the deterioration of the product. If bottled with carbon dioxide the fresh flavor is retained for a longer period. The addition of sugar also aids in preserving the fresh flavor. In pasteurizing these juices the temperature should not exceed 165° F. as high temperature affects the flavor.

A plain unconcentrated orange and lemon juice can also be sold, but the orange juice is more popular. The fruit used should be sorted to remove unsound, moldy, and rotten fruit. It should be thoroughly washed with potable water to remove dirt, dust, mold spores, smut, spray residues, and any other extraneous matter. The fruit is then cut in half by means of a revolving cone or burr. All parts of the process coming in contact with the juice should be made of non corrosive metal, such as Monel, Vinaloy, and Allegheny metals. The pulp and juice is then screened on a revolving or shaker screen to remove seeds, fiber and coarse pulpy material, which would impart a bitter flavor. The juice has considerable air either naturally present or incorporated due to the straining. This air must be removed to prevent an off flavor due to the oxidation. The outer rind known as flavedo and the white pithy substance or albedo must be largely eliminated and the orange oil must also be kept low so as not to give an objectionable stale flavor.

The juice after being expressed should be run into a glass lined tank where vacuum can be applied to remove entrapped air. The higher the vacuum that can be obtained, the better the flavor. After the air has been removed, nitrogen gas which is inert can be passed into the juice and then the juice can be bottled, using the nitrogen gas to force the juice from the holding tank.

If the juice is to be frozen, it can be frozen in ice cream freezers to a slush of the same consistency as fruit ices; then nitrogen or any other inert gas can be used to force it into the size containers desired with little head space. If possible, pass the filled cartons through an atmosphere of nitrogen gas before capping. Place in a sharp freezer where they are frozen at 10° F. and later stored at about zero.

Many processors are concentrating citrus juices. Methods have been developed by several equipment manufacturers to

CANNED SOUPS

Soups are usually divided into two general classes: (1) those made with stock; (2) those made without stock. The basis for the stock are beef, mutton, veal, fish, poultry, and game, either used separately or in combination.

Bouillon is made from lean beef, usually seasoned and cleared.

Brown soup stock is made from lean beef with bones and fat, and is usually very highly seasoned with spices, herbs and vegetables.

White soup stock is made from either chicken or veal, delicately seasoned.

Consomme is made from two or three different kinds of meat highly spiced with herbs, spices, and vegetables and then strained to produce a clear soup.

Mutton broth is made from lamb and is lightly seasoned.

All of the above are made with meat stock, and come under the first classification. Those considered under the second heading would include cream soups, purees, and bisques.

Cream soups can be made with vegetables, fish, spices, and other seasonings and thickeners.

Purees can be made with vegetables or fish that have been boiled until extremely soft and then rubbed through sieves, and embodied in the soup, to produce a very heavy body.

Bisques are similar to purees and contain small pieces of meat and vegetables.

To make good soups, the chief requisites are good raw materials, properly handled under sanitary conditions. The demand for this line of food product is becoming greater each year as they appeal to the busy housewife and can be used when emergencies arise.

As soups are liquid (such as bouillon) or semi-solid (as tomato soup), they should be handled as expediently as possible to prevent the development of bacteria which may be difficult to destroy by sterilization.

In preparing stock, cylindrical glass lined tanks equipped with coils are more desirable than wooden or copper kettles. On account of porosity, wooden tanks are undesirable, because the juices and fat penetrate, thus making the tanks not only difficult to clean but also present a rough surface for the bacteria to become implanted. Copper may impart a metallic taste and is therefore not used for the making of stock.

The enameled tank should be equipped with coils and in addition to the bottom draw off, there should be another on the side about 6 inches above the bottom so that the clear liquor can be removed for bouillon or broth. The tank should also have a removable cover.

SOUP STOCK:—When preparing soups, use the bony parts of beef, such as the head, shin, neck, and fore-quarters, trim off all fat, and strip the meat from the bones, crushing or cracking them so as to expose the marrow. Place in a sack or wire basket to prevent small particles of bone mixing with the broth. To 1000 pounds of beef and bones in the cooking vat, add 200 gallons of water or enough water to cover. Turn on the steam, put the cover in place, and cook very slowly for about 8 to 10 hours. At no time should the soup stock come to a boil, just a simmer. From time to time skim off the fat and coagulated albumen as it rises. If salt is added (it is best not to add it unless the soup stock is to be kept for several days) it should be put in after the meat is removed. Different vegetables and spice may be added to improve the flavor, but add near the end of the cooking—about one hour before finishing. Use the same vegetables and amounts as in consomme.

Unless the meat is to be used for mince meat or some such purpose, put it in a press to extract the juice or drain well.

and if not, add water to give the proper yield. It is the practice of some packers to use extract of beef to reinforce the broth and make a stronger soup, which may be diluted more when served, but the soup will not have as fine a flavor. If the extract is used, add about one pound of extract to each 50 gallons of soup stock.

The stock should be cooled to solidify the fat, but do not remove the fat until ready to use, as it is a protection from contamination. This fat is often saved and washed and then used to replace other fats in soups.

If a clear soup is to be made, cooling and allowing the sediment to be skimmed or precipitated will not always be sufficient. It may be necessary to clarify by using coagulants such as egg albumen or isinglass.

When albumen is used as the clarifying agent, it takes the white and shells from 3 to 4 eggs to clarify one gallon of stock. Separate the yolk of the egg which can be used for mayonnaise, then crush the shell to small pieces and add the shell and beaten white to the stock. Boil for about 2 minutes and then simmer from 15-20 minutes to coagulate the albumen and clarify. Skim and strain through felt bag, canton flannel, or cheese cloth. If seasoning is to be added, do so before attempting to clarify. On a large production line, the soup stock can be filtered using any good pressure filter or centrifuge.

Consomme stock is made by slow boiling or simmering equal parts of lean beef and veal for about 8 hours. Handle the same as the beef stock.

CREAM OF ASPARAGUS:—The butt ends cut from the asparagus that is canned are often used for soups. When canned asparagus is used, the liquid used for canning should also be added. If fresh asparagus is used it should be cooked with an equal amount of water. In either case pass the entire contents through screens or brush pulpers to remove the coarse fiber.

Meat soup stock	30 gallons
Asparagus — water	20 gallons
Asparagus — drained and pulped	20 gallons
Milk	20 gallons
Butter	6 pounds
Flour—or corn starch	5 pounds
Salt	2½ pounds
Pepper — white	9½ ounces
Onion juice	9½ to 10 ounces

Heat the butter, add the flour, and when well mixed add this to the milk that has been previously heated to boiling and cook until it thickens. Then add the asparagus water and pulp, salt and pepper, and cook a short time. Pass through brush finisher with 0.027 inch perforation screen. It may be necessary to either increase or decrease the amount of flour used depending upon its binding properties.

Some use corn starch because flour has more binding property. Some, however, object to the cooked taste of flour. Flour may be harder to store in factories than corn starch and may become infected with insects.

If there is a tendency for this soup to "curdle" then, instead of the milk, soup stock can be substituted or soya milk can be used.

Sterilize No. 1 size cans 30 minutes at 250° F., 28-30 ounce cans 50 minutes at 250° F.

BEAN SOUP:—Use 50 gallons of beef soup stock, 75 pounds of white beans, 2 pounds of salt, 2 ounces of white pepper, 2 ounces of ground coriander seed and 4 pounds of wheat flour. The addition of a small amount of ground garlic (about 1 ounce to the above) and the same amount of celery seed will also produce a better flavor. Soak the beans overnight, then cook them until they are soft; pass them through a 16-mesh sieve or the tomato pulping machine. Mix all of the ingredients together and put in a kettle, bring to a boil, then add the flour paste and cook until the soup commences to thicken. Fill into cans. Exhaust No. 1 cans 3 minutes and process 45 minutes at 235° F.

BEEF BOUILLON OR BROTH:—To prepare bouillon proceed in the same manner as for making the soup stock. After the stock is prepared, draw off the clear liquor either by means of a siphon, or through the outlet on the side of the cooking kettle. This permits the removal of a clear broth while the sediment remains in the bottom of the tank. Clarify by the addition of egg albumen or isinglass before canning. Add 10 ounces of salt and one-half ounce of ground white pepper to each 10 gallons of bouillon. Should spicing be desired, a small quantity of onion and celery may be added.

A concentrated bouillon can be made by increasing the spices and adding 1 pound of beef extract for each 50 gallons. Allow the bouillon to remain in the second, or settling tank, 24 hours, then carefully remove all grease, draw off the clear liquor and fill into No. 1 cans. Exhaust 3 minutes and process 30 minutes at 250° F. Use equal parts of bouillon and hot water when serving.

BEEF BROTH AND RICE:—Beef broth with rice is prepared the same as bouillon, with the addition of 10 ounces of rice to each gallon of bouillon. The rice should be soaked in hot water for 3 hours before being added to the broth, or blanched in boiling water for 25 to 30 minutes, using a blanching basket of fine mesh wire cloth. Fill No. 1 cans half full of the blanched rice and cover with the bouillon. Exhaust 3 minutes and process 30 minutes at 250° F. A more concentrated or condensed soup can be made by adding 1 pound of beef extract per each 50 gallons of stock.

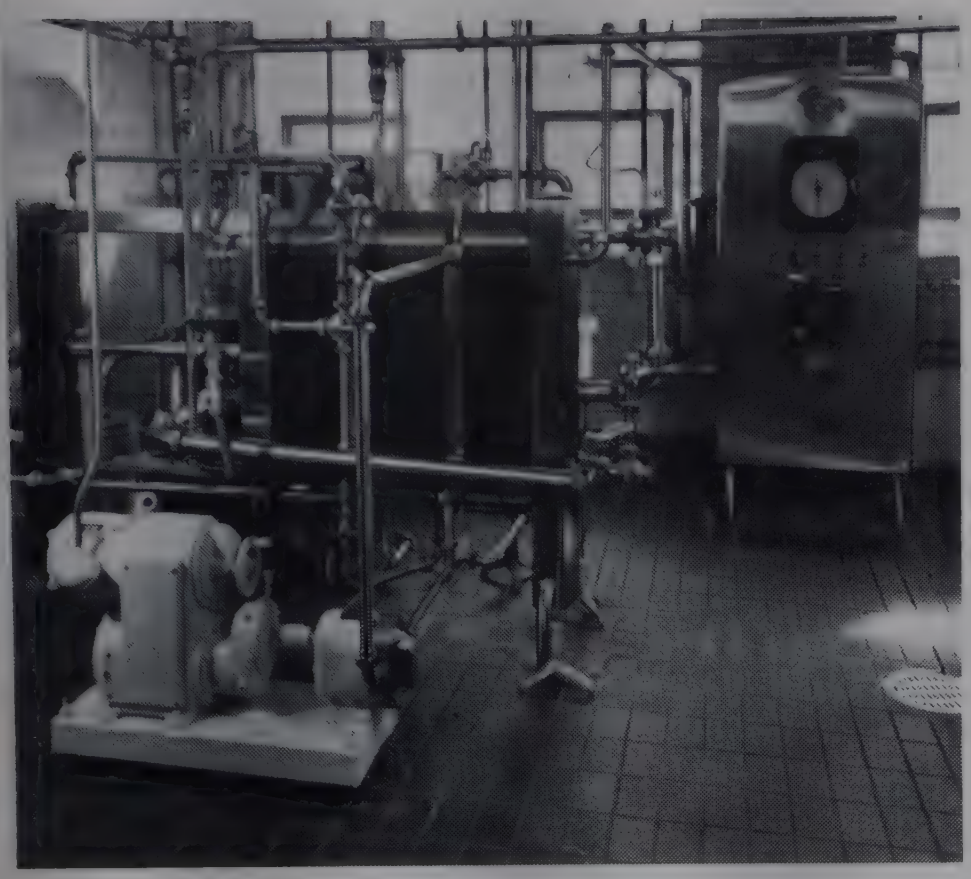
CONSOMME:—Use 50 gallons of consomme soup stock, 6 pounds of carrots, 2 pounds of parsley, 1 pound of onions, 1 ounce of garlic, 1 ounce of dry or powdered thyme, 1 ounce of white pepper, 3½ pounds of salt, and 4 pounds of well browned wheat flour. To brown the flour, put it in a dry copper jacketed kettle, turn on the steam and cook until the flour is the desired color. Or use the washed beef fat, brown the fat and flour together and then add. Chop all of the vegetables fine, adding them to the soup stock and spice in a kettle, and simmer about one-half to one hour. Then draw off the consomme and pass it through a double-napped canton flannel drip bag to filter; add the brown flour mixed to a thin paste, cook and run through a 20-mesh wire sieve. Fill the soup into No. 1 cans; exhaust 3 minutes and process 30 minutes at 250° F. Dilute one-half when serving. To make a condensed consomme, add twice as many vegetables and 1 pound of beef extract for each 50 gallons of finished product.

Cream of Celery Soup I

Chopped celery	24 gallons
Water — boiling	16 gallons
Milk	20 gallons
Butter	6 pounds
Flour or corn starch	5 pounds
Salt	2 pounds
Pepper — white	6½ ounces
Onion juice	9 ounces

Cook the cleaned chopped celery in the water until soft and pass it through finisher to remove the coarse fiber. Heat the butter and corn starch together and when well mixed add it to the previously heated milk and cook until thick. Then add the celery, salt and pepper and cook until well heated and again pass through the finisher. Fill hot. Cap and sterilize the same as asparagus soup. Instead of passing all of the cooked celery through the finisher about ¼ to 1/5 may be reserved and added to the cooked soup. If this is done, the soup should be well stirred as it is filled into cans.

The cooked celery may be ground through stone mills the



This sanitary plate heat exchanger pumps soups or juices at high speed through heating, holding and cooling cycles.

same as are used for mustard, to break down the fibrous materials, which makes a very smooth product.

Cream of Celery Soup II

Pulped or ground celery	25 gallons
Fresh milk	25 gallons
Meat stock	25 gallons
Corn starch	4 pounds
Butter	5 pounds
Salt	2 pounds
Ground white pepper	½ pound
Onion juice	½ pint

Pulp the celery by grinding through fine blades of food grinder. This breaks up the fiber. Some large processors pass the chopped celery through a mustard mill to grind all the pulpy material very fine. This also helps to suspend it and keep it in suspension.

Heat the stock to boiling and add the chopped celery with the salt, pepper, and onion juice. Heat the butter and corn starch together until thoroughly mixed and heat the milk. Add the corn starch mixture to the soup and then add the warm milk. Bring to a boil and fill hot. Cap and sterilize the same as above.

CREAM OF CORN SOUP:—Cream style corn is better for this soup than whole kernel, and yellow or golden bantam makes a richer looking soup than white corn.

Canned corn—2 doz. No. 10 tins or	20 gallons
Boiling water	20 gallons
Milk	20 gallons
Butter	5 pounds
Flour or corn starch	4 pounds
Salt	2 pounds
White pepper	6½ ounces

Cook the corn, water, salt and pepper together slowly for about 10 minutes and replace any loss. Heat the butter and flour together and when mixed well add it to the corn and [illegible] has some thickening property, the quantity of flour or corn starch can be reduced often to one-half of the above amount. Pass the finished batch through a brush finisher with 0.027-inch perforation. Can hot; seal [illegible]

Clam Chowder—Manhattan

Clams, finely chopped	12½ gallons
Fat salt pork, chopped in small pieces	37½ pounds
Onions, peeled and chopped	6¼ pounds
Potatoes, diced ¾-inch cubes	25 pounds
Boiling water	12½ gallons
Stewed tomatoes, strained if desired	12½ gallons
Salt	3½ pounds
Pepper, white	2 ounces
Celery seed, Mace (cooked together 10 min. before adding)	1 ounce each

Fry out the pork, add the peeled and chopped onions and fry for 5 minutes and strain or not, as desired. Add the potatoes, water, salt, pepper, and spices. Boil until the potatoes are nearly done. Add the tomatoes and cook and then add the clams and boil 3 minutes. Fill hot, but keep the soup well agitated the entire time. Cap, and sterilize.

CHICKEN SOUP STOCK:—Use 300 pounds of chicken and 100 gallons of water. Cook the chicken until the meat will strip from the bones, then return the bones to the stock and cook 2 hours longer. Use this soup stock for making the various soups. The chicken meats may be used for potted chicken, chicken tamales, brunswick stew, canned chicken, etc. When preparing the soup stock, after removing the meat, add enough additional water to make up the loss by evaporation.

CHICKEN BOUILLON OR BROTH:—Use 20 gallons of the chicken soup stock, and one ounce of white pepper. Heat the stock to 100°, then strain through a double-napped flannel drip bag. Add the pepper and 10 ounces of salt. Fill into No. 1 cans and process 30 minutes at 250° F. A slight amount of celery seed and a dash of garlic will improve the flavor. The addition of 1 pound of edible gelatine will increase the food value.

CHICKEN BROTH WITH RICE:—Prepare the chicken broth with rice in the same way as for beef broth with rice. Fill and process the same as beef broth and rice.

CHICKEN WITH NOODLES I:—To 20 gallons of chicken soup add 8 ounces of salt, 2 ounces of white pepper, several stalks of chopped celery and 10 pounds of egg noodles. Cook together until the noodles are still firm but not soft; fill the noodles into the cans and then fill with the hot broth. Cap, sterilize the same as for beef broth and rice.

The noodles used in this product should comply with the government standard; namely, contain at least 5½% egg solids.

CHICKEN NOODLE SOUP II:—Cook 8 ounces of fine noodles in one-half gallon boiling water (salted) 3 minutes. Drain in colander. Flush with cold water to remove excess starch. To one gallon of boiling chicken broth, add cooled noodles, boil two minutes. Season to taste.

OLD LOUISIANA CHICKEN GUMBO:—Use 20 gallons of chicken soup stock, 10 pounds of ham, 12 pounds of minced chicken, 2 pounds of onions, 3 pounds of butter, 1 ounce of white pepper, 1 pound of salt, and 2 pounds of wheat flour. Cut the ham into cubes; mince the chicken; chop the onions very fine. Cook the ham in the soup stock about 1 hour. Make a thin paste of flour, add this, with the salt, pepper, butter, chicken and onions to the soup stock, bring it to a boil, and add 10 ounces of Louisiana Gumbo filé, or powdered okra mixed with 2 quarts of water. The flour can be browned in the butter and then added as this makes a richer product. Exhaust 3 minutes, process 40 minutes at 250° F. for No. 1 cans.

MOCK TURTLE SOUP:—Use 50 gallons of beef soup stock, 8 pounds of ham, 2 pounds of onions, 2 ounces dry or [illegible] parsley, 2 ounces of powdered bay leaves, 3 ounces powdered coriander seed, 4 pounds of

lemons, 4 pounds butter, 6 pounds of wheat flour, 3 pounds of salt and 1 ounce of white pepper. Cut the ham into cubes about ¼ inch square; cube the lemons; chop the onions and parsley. Mix the butter and flour by first heating the butter until it is soft, then work in the flour and cook until it has a nice brown color. Put the soup stock into a kettle, add the ham, spice and salt; cook 10 minutes longer; add the flour and butter, stirring all the time, and cook until it thickens to about the density of light catsup. Fill into No. 1 cans, stirring well all the time, seal and exhaust 3 minutes and process 30 minutes at 250° F. As there is a difference in the amount of gluten in flour, it may be necessary to add more to obtain the required density. Dilute one-half when serving.

Cream of Mushroom Soup I

Mushrooms	10 pounds
Chicken soup stock (see chicken stock)	5 gallons
Pearl Sago tapioca	2 pounds
Boiling water	1¼ gallons
Heavy cream (30-32%)	1¼ gallons
Egg yolk	2 pounds
Salt	3 ounces
Pepper	½ ounce

Clean and chop the mushrooms fine and add them to the soup stock. Cook for 20 minutes and rub or brush through a sieve. Cook the sago in the boiling water for ½ hour and add it to the stock and when boiling add the salt, pepper and the egg yolk which has been slightly beaten. This is a rich soup and instead of the extra rich cream, a coffee cream may be substituted, but the flavor will not be as good. Cap and sterilize the same as other soups.

Cream of Mushroom Soup II

Mushroom stems fresh	10 pounds
or Mushrooms	5 pounds
Butter	2½ pounds
Flour	10 ounces
Milk	5 gallons
Salt	4 ounces
White pepper	¾ ounce
Cayenne pepper	1/16 ounce

Wash the mushrooms but do not peel unless the skin is thick. Chop the mushrooms very fine and cook or brown in butter for about 5 minutes. Stir in the flour, and then stir in the milk slowly. Add the seasoning and cook until properly thickened. Fill hot into cans but keep the soup well stirred during this process; cap and sterilize the same time and temperature as given for other soups.

OXTAIL SOUP:—The stock used in this soup is made by cooking 1000 pounds of ox tails in 200 gallons of water.

Use 50 gallons of the soup stock, 2½ ounces of ground cloves, 5 ounces of ground coriander seed, 1 ounce of ground fennel seed, 2½ ounces of ground bay leaves, 1 ounce celery seed, 20 ounces of granulated sugar, 1 ounce of white pepper, 2 ounces of butter and 6 pounds of wheat flour. Melt the butter, add the flour and sugar and cook until brown. Then make a thin paste by adding one gallon of warm—not hot—water to the mixture, then adding to the paste the soup stock with the spice and three pounds of salt, and cook all together until the soup begins to thicken. Fill into No. 1 cans. Exhaust 3 minutes, process 30 minutes at 250° F. Dilute one-half when serving. Various vegetables are often added. To make a concentrated soup double the ingredients and add 1 pound beef extract for each 50 gallons of stock.

OKRA SOUP:—Use 50 gallons of beef soup stock, 75 pounds of okra, 2 ounces of white pepper, 3 pounds of salt, 4 ounces of powdered coriander seed, 2 ounces of powdered cloves, 15 pounds of rice. Slice the okra into discs, blanch 10 minutes and chill. Blanch the rice 25 minutes. Add the spice and salt to the soup stock, mix the okra and rice. Fill No. 1 cans half full of the okra and rice mixture and cover with the soup stock. Exhaust 3 minutes, process 30 minutes at 250° F.

SOYA MILK STOCK:—Soak soya beans over night in water to which a small amount of soda has been added. 80 pounds of dry beans swelled will produce 35 gallons of soya milk stock when pressed or 1 gallon of swelled beans produces 1 gallon of milk.

Soya milk can be substituted for milk, in products where there is a tendency for cow's milk to curdle. Soya milk will not produce as rich a flavored product as cow's milk, but it will prevent curdling and give very good results.

OYSTER SOUP:—One great difficulty in making oyster soup is to produce a product that will not curdle. A plain broth is all right, but when milk or cream is used, the product curdles. Cracker meal can be added to the plain broth to thicken the soup. If a vegetable milk made from the soya bean is substituted, this curdling will not occur, consequently a much richer product can be made.

Soya milk stock		30 gallons
Shucked oysters		15 gallons
Butter		3¾ pounds
Salt		4½ pounds
White pepper		3 ounces
Corn starch		16 pounds
Celery seed	Cook together in a little	1½ ounces
Mace	water for about 10 min.	1½ ounces
Oyster broth		5⅝ gallons
Water		7½ gallons

This gave a yield of 420 two-pound cans. On account of the price of oysters, some oyster broth can be substituted. This broth can be obtained when the cove oysters are steamed for canning. If this broth is to be used, the oysters should be thoroughly washed and sprayed in a tumbler washer to remove sand and dirt before steaming and the retorts should have heavy tinned pans to collect the broth, otherwise the broth will turn dark after sterilizing. If possible the broth should be filtered or at least strained several times before using.

Green Pea Soup

Soup stock—either veal or chicken	20 gallons
Peas—cooked or canned	12½ gallons
Cold water	6 gallons
Onions	8 ounces
Bay leaves	1/64 ounce
Mace	1/16 ounce
Sugar	36 ounces
Salt	1 pound
Pepper	4 ounces
Butter	6¼ pounds
Corn starch	3½ pounds
Milk	6½ gallons

Add the peas to the soup stock, the water and seasoning and slowly cook ½ hour. Pass through a brush screen finisher. Heat the butter and the corn starch together and add it to the soup and boil for 5 minutes, then add the milk and cook until thickened. The drained water from the peas can be substituted for the water. Fill hot into cans, seal and sterilize the same as other soup. Cool immediately to prevent scorching. If fresh peas are available they are used in preference to the canned because of better flavor and color.

SCOTCH PEA SOUP:—Use dry Scotch peas for preparing this soup. Use 50 gallons of soup stock, 75 pounds of Scotch peas, 2 pounds of salt, 6 pounds of granulated sugar and 4 pounds of wheat flour. Prepare the peas until they are soft by steaming in the retort. If this method is used, first soak

the peas over night, then steam for 35 minutes at 230° F. Add about half of the soup stock to the peas and pass through the pulping machine, using a 16-mesh wire cloth; then add the balance of the soup stock, the sugar and salt. Make a paste of the flour, add it to the soup, and cook until it begins to thicken. Fill into No. 1 cans, cap, exhaust 3 minutes, and process 30 minutes at 250° F. A thinner product can be made by reducing the amount of peas to 30 pounds per 50 gallons of stock. Split peas can also be substituted for the Scotch peas.

Pepper Pot Soup

Cream, 30%	2 gallons
Sliced onions	1 gallon
Chopped celery	1 gallon
Chopped green peppers	1 gallon
Potatoes cubed or diced	6 gallons
Butter	8 pounds
Flour	4¾ to 5 pounds
Soup stock (chicken or lamb broth)	20 gallons
Tripe, honeycomb, (chopped in cubes)	32 pounds
Cayenne pepper	3½ ounces
Salt	1 pound

Cook the vegetables in 6 pounds of butter for 15 minutes and then add the flour and mix well. Then add the other ingredients except the cream. Simmer for 1 hour, and then add the cream and the remaining 2 pounds of butter, cook for a few minutes to incorporate and fill hot. Exhaust No. 1 can for 3 minutes and sterilize 30 minutes at 250° F.

CREAM OF POTATO SOUP:—Use 50 gallons of soup stock, 15 pounds of thin sliced potatoes, 2 pounds of salt, 2 ounces of white pepper, 5 pounds of butter, and 3 pounds of wheat flour. Blanch the potatoes 5 minutes and add them to the soup stock with the salt, pepper, and butter; bring to a slow boil for 10 minutes, then add the flour paste and cook 3 minutes longer. The potatoes can be diced by running through a dicing machine. Fill into No. 1 cans. Exhaust 3 minutes, process 35 minutes at 250° F.

Cream of Spinach Soup

Soup stock, either veal or chicken	25 gallons
Spinach, cooked or canned	10 gallons
Milk	12 gallons
Butter	12 pounds
Flour	8 pounds
Salt	1 pound
Pepper	3 ounces

Pass the spinach through the fine blade of a meat grinder and add it to the soup stock, and pass all through a brush finisher. Heat to the boiling point, add the flour and butter which have previously been heated together and then add the milk, salt and pepper. Boil until of the proper consistency, fill hot, cap and sterilize.

Scotch Broth

Lamb or mutton (shoulder or chuck)	30 pounds
Water	3¾ gallons
Barley	2½ gallons
Butter	1¼ gallons
Carrots	20 ounces
Celery	20 ounces
Onion	20 ounces
Turnip	20 ounces
[illegible]	3 ounces
[illegible]	½ ounce
[illegible]	5 ounces

Soak the barley overnight in cold water. Cut the meat into 1 inch cubes and place in the kettle with the water and until the meat is tender. Place the bones in a separate kettle, cover with cold water, and heat slowly to boiling point, skim and boil 1½ hours. Strain this broth and add to the meat stock. Fry or brown the chopped or diced vegetables in about ½ the butter, add to the soup with the necessary salt and pepper and cook until the vegetables are soft. Mix the flour and the remaining butter together and add it to the soup and cook until it begins to thicken. When filling into cans, keep the mixture well stirred. Cap and process the same as for vegetable soup.

Scotch Soup

Mutton—fore quarter	30 pounds
Cold water	5 gallons
Salt (5 tablespoons)	3 ounces
Pepper	½ ounce
Onion	½ pound
Carrots—diced	1½ pounds
Turnips—diced	2 pounds
Pearl barley	1 pound
Flour	10 ounces
Water	20 ounces

Clean the meat and remove the skin and fat and cut into small pieces. Add the water and heat slowly to the boiling point, then skim and cook slowly for 2 hours. At the end of 1 hour cooking, add the salt, pepper, and onion, and continue for another hour. Strain, cool, and remove the fat and then reheat again and thicken with the flour which has been mixed and diluted with the 20 ounces of cold water. The diced carrots and turnips should be cooked in salted water until soft but not "mushy." Drain and add them to the soup. The barley should be soaked overnight in cold water, drained and then cooked in salted water until soft; drain and add this to the soup. Do not cook the barley in the soup but add it later to prevent the barley from absorbing the flavor of the meat.

When filling into cans, keep the soup well stirred so as to evenly distribute the solid ingredients. Cap, and sterilize the same as for vegetable soup.

High Grade Cream of Tomato Soup

100—1 gallon cans of tomato pulp (Specific gravity 1.022), or

120—No. 10 tins of tomato pulp.

Reduce the volume at least one-half and then slowly add 1 pound of bicarbonate of soda mixed or dissolved in small amount of water to reduce the excess acidity, thus preventing the curdling of the milk or cream. (See method of adding to tomato paste.)

To 15 gallons of this pulp, use the following:

Finely chopped onions (washed and peeled)	1 gallon
Bay leaves (chopped)	1/32 ounce
Broken cinnamon	2 ounces
Whole cloves	2 ounces
Allspice (whole)	2 ounces
Ground white pepper	3 ounces
Powdered cayenne	¼ ounce

Slowly cook to 12½ gallons and run through the finishing machine. Heat the balance of the pulp to 145° F. and add 5 gallons of a 30% cream and allow it to remain in the kettle about 40 minutes.

Mix four pounds of arrow root or corn starch in cold water, add to the above 10-18 pounds of sugar (depending entirely upon the desired sweetness) and 8-12 pounds of salt and the 12½ gallons of spiced stock, then slowly bring to a boil for about 5 minutes and run through a finisher of the shaker type to obtain the best results.

Some pass the product through a homogenizer to break up the fat globules in order to make it more stable and prevent

separation and curdling. Fill into cans hot, and sterilize No. 1 cans 35 minutes at 240° F.

This should produce 65 gallons of high grade soup.

The sugar and salt are varied depending upon the character of the tomatoes used, if the tomatoes are low in acid and high in sugar a smaller amount of both can be used, whereas if the tomatoes are high in acid then a larger amount of sugar and salt is used to equalize the sweetness.

Arrowroot starch (imported) gives a better result for thickening than corn starch.

A shaker finisher does not break up the emulsion formed in the soup as readily as a catsup finisher.

As tomato soup is a delicate food, in making it, no rule can be followed as to taste. Watch the strength of the bay leaves used. A slight dash of garlic may be used (¼ ounce) per batch. Butter can be substituted for the cream, using 5 to 7 pounds. Add it to the pulp and it will readily distribute when melted and cooked.

Handle the same as outlined for cream of tomato soup. Process the same—No. 1 cans 30 minutes at 250° F. and 28-32 ounce cans 50 minutes at 250° F.

TOMATO SOUP NO. 2:—Use 102 gallons of peeled tomatoes, or 100 gallons of pulp with specific gravity 1.022

Sugar	13 pounds
Salt	8 pounds
Cayenne pepper	¼ ounce
Whole cloves	1½ ounces
Ground white pepper	1½ ounces
Whole allspice	1½ ounces
Bay leaves	½ ounce
Fresh butter	7 pounds
Worcestershire sauce	½ pint
Patent flour	18 pounds
Parsley	5 bunches
Onions	1½ gallons
Celery seed	6 ounces
Bicarbonate of soda	1 pound

PLAIN TOMATO SOUP WITH MILK:—Most manufacturers have abandoned the use of milk in soup-making, especially those who make a concentrated one, on account of curdling. The following formula is for soup with milk. Use 7 gallons of finely chopped tomatoes, thick tomato soup stock, or concentrated pulp. 10 gallons of fresh milk, 5 gallons of water, 3 ounces of bicarbonate of (baking) soda, 1 ounce of black pepper, and 2 pounds of granulated sugar. Cook the tomatoes in 5 gallons of water with the salt, sugar, and pepper, until they come to a boil, then add the bicarbonate of soda and cook for 10 minutes, then run through a finisher. Heat the milk to 200° F. for 10 minutes, in a separate kettle, adding 1 pound of butter, then mix the two preparations, bring to a slow boil and add the flour paste. Cook for 5 minutes and fill into cans. Exhaust 3 minutes, process 45 minutes at 250° F. Under no circumstances should the milk be added until it is heated up to 200°, otherwise it will curdle.

TOMATO SOUP NO. 3:—Use 50 gallons of chopped tomatoes (or 60 No. 10 cans), or 75 gallons of tomato soup stock concentrated to 60 gallons, 5 pounds of butter, 3½ pounds of salt, 3 ounces of white pepper, ½ pound of bicarbonate of soda, 12 pounds of wheat flour, 2½ pounds of granulated sugar, and 10 gallons of water. Put the tomatoes into a kettle, add half of the water (reserving the remainder for the flour paste). If a clear tomato soup stock is used, omit the water. Bring to a boil, then add the soda slowly, to prevent sudden foaming. Then add the rest of the ingredients, thicken with the flour dissolved in the remaining 5 gallons of water. Exhaust No. 1 cans 3 minutes, process 30 minutes at 240° F.

VEGETABLE SOUP I:—Use 50 gallons of beef soup stock, 10 pounds of carrots, 4 pounds of turnips, 3 pounds of washed celery (both stock and leaves), 2 pounds of onions, 2 pounds of dry lima beans, 6 pounds of potatoes, 3 ounces of red chili peppers, 4 pounds of pearl barley, 5 pounds of rice, 2 pounds of salt (if there has been no salt added to the broth), 1 ounce of garlic and ½ ounce of powdered thyme.

Cut all of the vegetables into small cubes about ¼-inch square, chop the garlic and red peppers fine. Blanch the vegetables 15 minutes and chill in cold water. Soak the lima beans and rice over night and cook the pearl barley from 2 to 3 hours. Prepare the soup stock or broth by adding 5 pounds of wheat flour. Mix the flour to a thin smooth paste and add to the soup stock, then add the vegetables, and fill into cans.

Exhaust No. 1 cans 3 minutes, process 35 minutes at 240° F. This soup can be diluted with an equal volume of hot water. A more concentrated soup may be prepared by adding 1 pound of beef extract to the soup stock, but the flavor will not be as delicate as that made from soup stock alone. Exhaust No. 1 cans 3 minutes, process 30 minutes at 250°, or 45 minutes at 240° F.

Vegetable Soup No. 2

For a 135-gallon batch use the following:

Butter	6 pounds
Onions (Texas)	12 pounds
White flour	12 ounces
Water	65 gallons
Barley	20 pounds
Cabbage (cut)	16 pounds
Pulp (1.045)	16 gallons
Herbex—vegetable extract (in 1 gal. water)	9 pounds
No. 10 can tomatoes (or 20 No. 3 cans)	7 cans
Pepper (Mixed with 8 oz. salt)	2¼ ounces
Salt (Besides above)	16½ pounds
Sugar	8 pounds
Spiced tea (see below)	40 ozs.—fluid
Sage	5 pounds
White potatoes (diced)	75 pounds
Celery (cut)	13 pounds
No. 2 corn	20 cans
No. 3 okra	10 cans
Yellow turnips (Blanch (discarding water)	40 pounds
Carrots (Blanch (discarding water)	30 pounds
No. 2 peas	20 cans
No. 2 lima beans	20 cans
Alphabets	10 pounds
Celery water	2 quarts
Cereals (Mixed with 8½ gal. water)	
Corn starch	20 pounds
Rice	10 pounds
Corn flour	10 pounds

Spiced Tea

To make 5 gallons of the tea use:

Allspice	4.25 ounces
Celery seed	25.00 ounces
Parsley seed	22.50 ounces
Sweet basil	3.50 ounces
Thyme	5.25 ounces

Place spices in 5 gallons of cold water for five minutes stirring occasionally. Then simmer for 15 minutes stirring most of the time. Then strain through cheese cloth, washing the spices with enough additional hot water to make 5 gal-

lons. After straining replace the amount of liquid lost in simmering and that retained by spices by washing the spices with hot water until you have five gallons. Two quarts of this solution will be required for a 160-gallon batch.

Vegetable Soup No. 3

For a 125-gallon batch use the following:

Butter melted in kettle	10	pounds
Chopped onions, browned	12½	pounds
White flour	1	pound
Q. S. water to make 55 gallons and bring to boil		
Chopped cabbage	22	pounds
No. 10 cans tomatoes	10	cans
Pulp previously run through finisher	18	gallons
Celery (cut)	13	pounds
Carrots (diced)	50	pounds
White potatoes (diced)	80	pounds
Sweet potatoes (diced)	40	pounds
Salt	15½	pounds
Pepper (Mixed with 1½ pounds salt)	2½	ounces
Garlic powder (3 to 1) (Mixed with 1½ pounds salt)	1½	ounces
Sugar	10	pounds
No. 2 cans crushed corn	15	cans
No. 2 cans shoe peg corn	5	cans
No. 2 cans limas	30	cans
No. 10 can tea from celery roots and leaves	1	can
Spiced tea	50	ozs.—fluid
Herbex—vegetable extract (similar to beef extract)	8½	pounds

There should be 115 gallons at this point. Bring to rapid boil, add 18 pounds whole wheat flour and 20 pounds corn starch, previously mixed with 8 gallons water.

Change order of adding materials if necessary to get uniform cook. Keep stirring while dipping into filler.

MAKING VEGETABLE SOUP 2 AND 3:—Place the butter in the kettle and warm. Add the finely chopped onions. Brown the onions by stirring in the wheat flour and heating. Add sufficient water to make sixty gallons. Bring water to boiling, and if barley is used, add it and cook for 4-5 minutes with water, little more than simmering. Stir continuously. Time of cook for barley depends largely upon size of grains. Should be cooked until medium soft.

Add the "Herbex" (vegetable extract) (approximately 1 ounce per 1 gallon soup). This should have previously been dissolved in about 1 gallon of warm water. This material contains chlorides which should be determined and calculated as salt. Add the salt. The total salt content should be about 2½ ounces per gallon or 325 ounces for a 130 gallon batch. If salt is determined in vegetable extract as 50% then the 16 pounds is correct. If more or less than 50% adjust amount of added salt so that total will be 325 ounces per 130 gallon batch. The 325 ounces include the salt used in mixing the pepper. Add the pepper. Sprinkle into the boiling mixture 4 pounds of small Sago, if and when used. If alphabets are used add ten pounds.

Next add tomato pulp of 1.040 gravity, which is free from specks. If the pulp has some specks put through finisher first. Add the cans of tomatoes which have been cut up somewhat so that none of the pieces are much more than an inch across. Then add the celery, cut into medium fine pieces. Add the cans of shoe peg corn, including the liquor. Then the sweet potatoes cut in ⅜-inch cubes. Add the white potatoes cut into cubes. The batch at this point will measure about 100 gallons.

Then add cans of okra cut into lengths of about 3/16-inch. The tomato length in the cans is cut just in half. Then add the cans of peas. Use peas that are not too soft. Include the liquor. Then add the (approximately one-third ounces per

which were blanched by placing in water, bringing to boil, and then drained. (The water is discarded.)

The soup is brought to a good boil and the filler-water mixture is added with good stirring. The filler mix is made by mixing the corn starch and rice flour with about 8½ gallons of water. The batch at this point should be about 130 gallons. Soup is drawn off while stirring into filling kettles. Process 45 minutes at 240° F., then cool.

Suggested Label Weights (Net Weight)

Soup, Concentrated		Lbs.	Ozs.
Bouillon (Sp. Gr. 1.04)			
8Z Tall	211x304	.	8¼
No. 1 Picnic	211x400	.	10½
No. 303	303x406	1	.
No. 303 Cylinder	303x509	1	5
No. 2 Cylinder	307x512	1	9
No. 3 Cylinder	404x700	3	1
No. 10	603x700	6	8
Pea Soup (Sp. Gr. 1.05)			
Same weight as Tomato Soup.			
Tomato Soup (Sp. Gr. 1.05)			
8Z Tall	211x304	.	8½
No. 1 Picnic	211x400	.	10½
No. 303	303x406	1	.
No. 303 Cylinder	303x509	1	5
No. 2 Cylinder	307x512	1	9
No. 3 Cylinder	404x700	3	2
No. 10	603x700	6	9
Vegetable Soup (Sp. Gr. 1.07)			
No. 1 Picnic	211x400	.	11
8Z Tall	211x304	.	8½
No. 303	303x406	1	.
No. 303 Cylinder	303x509	1	5
No. 2 Cylinder	307x512	1	10
No. 3 Cylinder	404x700	3	3
No. 10	603x700	6	11

Soup, Ready-to-Serve		Qts.	Pts.	Fl. Ozs.
8Z Tall	211x304	.	.	7¾
No. 1 Picnic	211x400	.	.	9½
No. 303	303x406	.	.	15
No. 303 Cyl.	303x509	.	1	3
No. 2 Cylinder	307x512	.	1	7
No. 3 Cylinder	404x700	.	1	14
No. 10	603x700	3	.	.

SPAGHETTI

Canned spaghetti is popular for quick lunches and provides another variety of diet. The best dry spaghetti is made from hard northern grown Durum wheat which is high in gluten and ash, whereas soft spring and winter wheats are low in ash and gluten. The hardy wheats have a higher gluten content which gives them their peculiarly delicious nutty flavor and the desired elasticity.

COOKING OF THE DRY SPAGHETTI:—Cook 50 pounds of dry spaghetti in a steam jacketed kettle for 30-35 minutes. This time can be reduced to from 20-25 minutes or even as low as 15 minutes as this makes a firmer product but then less spaghetti must be used in each can because of the "swell" during processing. An 11% moisture spaghetti blanched in salt water containing 1 pound of salt and 20 gallons of water gave the following "swells."

Minutes blanched	Original Weight ounces	Weight after blanch ounces	Weight-water taken up ounces
6	32	62.5	30.5
9	32	72.5	40.5
12	32	76.5	44.5
15	32	85.0	53.0

Remove and flush with cold water to stop further cooking

and prevent disintegration. Disgard the free starch. This may be done by dumping the cooked spaghetti onto a moving wire belt where it is flushed or washed as it passes on to the fillers. By this method, the product can be handled quickly and washed thoroughly.

Spaghetti Sauce—(24 gallon batch)

Tomato paste—24% solids	4 gallons or
Tomato pulp—S. G. 1.035	11¼ gallons
(neutralize one-half of the acidity—see tomato paste for neutralization)	
Cheese—sharp, snappy—ground fine	4 lbs., 6 oz.
Salt	5½ pounds
Sugar	2 pounds
Cayenne pepper	½ ounce
Corn starch (creamed in cold water)	2½ pounds
Onion juice	16 pounds
Beef extract	6 ounces
Spiced liquor (see below)	1 batch
Water to make	24 gallons

Spiced Liquor

	20 batches	1 batch
Garlic ground	20 oz.	1 oz.
Mace	40 oz.	2 oz.
Cloves	27 oz.	1⅓ oz.
Celery seed	11 oz.	½ oz.
Bay leaves	1⅓ oz.	1/15 oz.

Cook in a covered enameled vessel to prevent evaporation loss. Cook all of the spice either in bags or loose by covering 2 to 3 times its volume in water from ½ to ¾ of an hour. Drain the spiced liquor and wash thoroughly with hot water to remove the flavor from the spice and then make up to a definite volume. Divide for the individual batches. Do not use a copper kettle as copper will impart a metallic astringent taste and off color. If the spices were cooked in the batch, time is not sufficient to extract the full flavor from the spice so that a spiced tea is made and added to each batch of sauce. Some seasoning manufacturers or extractors package spices (liquid or dry) in exact amounts for each batch.

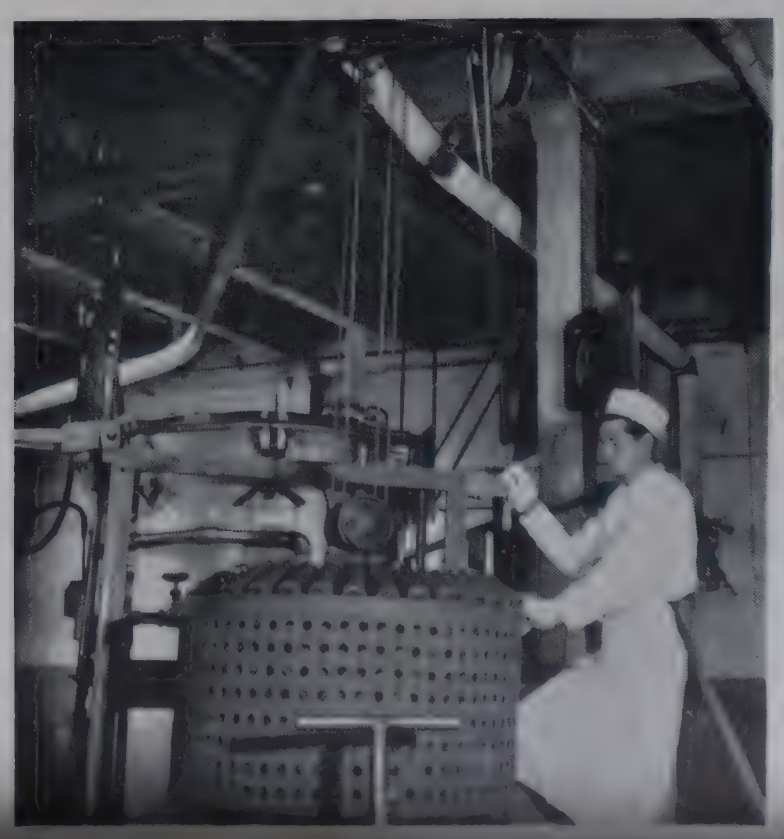
Paste produces a better flavor but if it cannot be obtained, use tomato pulp, however, neutralize ½ of the acidity in the cooking kettle before adding any of the other ingredients. The neutralization has been fully discussed under tomato paste, giving the amounts of baking soda necessary. It is better to grind the cheese through the fine plate as it dissolves better than when added in large pieces. A sharp, snappy Wisconsin or New York cheese that is at least one year old is best. It is often advisable to select your cheese some time in advance of your needs and keep it in storage. When "Roman" or Italian cheese is used, it is often grated and a measured or weighed amount added to each can, but when the cheese is incorporated in the sauce, a better flavored and more uniform product results. Few of the companies today are adding the cheese direct to the cans.

If onions are used directly in the sauce they must be very finely ground but if onion juice is used, then cook the

Carefully measuring ingredients prior to adding them to Italian type sauce for spaghetti. A piece of cheese is often added to each can, but when grated cheese is incorporated in the sauce a better flavor and more uniform product will result.

Cooking Italian type spaghetti sauce. Do not use copper-lined kettle, as copper will impart metallic taste and off-color.

Glass jars of spaghetti sauce ready for retorting. This sauce is for packaging with dry spaghetti in "dinner" style pack.



onions in a little water for 5 minutes and press and use this extract. The corn starch is mixed with cold water and stirred as it is slowly emptied into the cooking sauce. The beef extract can be mixed in the spiced tea or onion juice or water before adding. A concentrated vegetable extract similar to beef extract is often substituted for the beef extract. This sauce batch of 24 gallons is sufficient to cover 50 pounds of cooked spaghetti or make a total of 43¾ gallons of spaghetti and sauce.

The general practice is to add cooked spaghetti to the cans, fill with sauce, cap, invert and process or sterilize. Some have taken the cooked spaghetti and added it to the finished sauce. This method is not as satisfactory because it is quite difficult to apportion the sauce and spaghetti and to pack it uniformly.

Have the sauce as near the boiling point as possible when added to the spaghetti: 205-210° F. No. 10 cans should be thoroughly cooled after processing to prevent further cooking in the can.

For a six-ounce can, fill 3 ounces spaghetti and 3 ounces of sauce and for a 14-ounce can fill 7 ounces each of spaghetti and sauce. Should a more moist product be desired, 3½ ounces and 8 ounces of sauce respectively can be used. Use 41 ounces cooked spaghetti (15 min.) per No. 10 tin.

Process at 240° F.
6 ounce for 30 minutes
14 ounce for 30 minutes
16 ounce for 35 minutes
No. 3 can for 45 minutes
No. 10 can for 110 minutes

Spaghetti processed at this high temperature has a great swell and should a more moist product be desired, reduce the spaghetti going into each can and increase the sauce. While half spaghetti and half sauce produces a very nice finished product, a more moist package has a better flavor.

The following is another good formula for spaghetti sauce:

Tomato pulp (S. G. 1.040 or its equivalent in pulp)	200	gallons
Sugar	220.0	pounds
Salt	85.5	pounds
Onions, chopped	122.5	pounds
Cheese—grated or ground fine	52.5	pounds
Corn starch	42.0	pounds
Cracker meal	30.0	pounds
Celery seed	10⅛	ounces
Parsley seed	10⅛	ounces
Pepper, white	3	ounces
Thyme	2⅛	ounces
Allspice	2⅛	ounces
Cloves, whole	2⅛	ounces
Sodium bicarbonate	6	ounces
Water to make	640	gallons

Place the pulp in the kettle, heat and slowly add the bicarbonate of soda which has been mixed with some water so as not to cause too much foaming. Add the sugar as soon as possible to "set" the color; the onions, the white pepper and the other spices are added in a bag. When boiled for about 5 minutes, add the cheese and cook until it has been dissolved, then add the corn starch which has been mixed or "creamed" with water and cook until a smooth paste and then dust the cracker meal over and mix it in well. Cook for about 10 minutes in order to extract the flavor from the spice. If desired, the sauce can be run through a fine sieve to remove specks or the spice if cooked loosely in the batch. Fill hot at least 190° F. on the cooked spaghetti.

Suggested Label Weights (Net Weight)

Spaghetti (Sp. Gr. 1.00)		Lbs.	Ozs.
——	211x210	.	6¼
8Z Tall	211x304	.	8½
No. 1 Picnic	211x400	.	10½
No. 300	300x407	.	15
No. 2½	401x411	1	13
No. 10	603x700	6	10

SALT TABLE

Salt Percentages; Corresponding Baume and Salometer Readings, and Quantity of Salt Required for One Gallon of Water at 20+or—4° C.

Percent Salt	Degrees Baumè	Salometer Degrees	Sp. Gr. at 20+or—4°C.	Salt required per 100 gal./water to nearest ounce		Oz. Salt per gallon water
1	0.8	4	1.0053	8 lbs.	6 oz.	1.3
2	1.8	8	1.0125	16 "	14 "	2.7
3	2.8	11	1.0196	25 "	19 "	4.1
4	3.8	15	1.0268	34 "	4 "	5.5
5	4.8	19	1.0346	43 "	3 "	7.9
6	5.8	23	1.0413	52 "	2 "	8.3
7	6.7	26	1.0486	61 "	5 "	9.8
8	7.7	30	1.0559	70 "	8 "	11.3
9	8.7	34	1.0633	79 "	14 "	12.8
10	9.6	38	1.0707	89 "	6 "	14.3
11	10.5	42	1.0782	99 "	0 "	15.8
12	11.5	45	1.0857	108 "	11 "	17.4
13	12.4	49	1.0933	118 "	10 "	19.0
14	13.3	53	1.1009	128 "	10 "	20.6
15	14.2	57	1.1085	138 "	10 "	22.2
16	15.1	60	1.1162	149 "	0 "	23.8
17	16.0	64	1.1240	159 "	8 "	25.5
18	16.9	68	1.1319	170 "	0 "	27.2
19	17.8	72	1.1398	180 "	13 "	28.9
20	18.7	76	1.1478	191 "	10 "	30.7
21	19.5	79	1.1559	202 "	10 "	32.4
22	20.4	83	1.1640	213 "	11 "	34.2
23	21.3	87	1.1724	225 "	2 "	36.0
24	22.2	91	1.1804	236 "	4 "	37.8
25	23.1	94	1.1888	248 "	2 "	39.7
26	23.9	98	1.1972	260 "	0 "	41.6
26.5	24.3	100	1.2014	265 "	10 "	42.5

Section 2—Preserving

Chapter I

Principles Involved in Preserving

Man on platform is striking vacuum evaporator for a sample of preserves. Vacuum operates at low heat, prevents scorching.

PRESERVES, jams, marmalades, butters, jellies and related items have been well standardized and defined either through usage, Standards of Identity, or Food and Drug Administration regulations. The difference between preserves, jams, marmalades, and butters is primarily one of terminology that has developed in the industry and by consumer usage. The term "Preserve" connotes relatively larger pieces of fruit than does the term "jam". The term "marmalade" usually connotes a product made from citrus fruits. "Butters" usually refers to products made from strained fruit pulp. "Jelly" refers to the clear, gelled juice extracted from fruits. The ingredients used in making these products, the proportions of fruit to sugar or fruit juices to sugar, and the final concentration (soluble solids) have been defined by regulations.

FRUITS:—The fruit used in preserving, if fresh should be at the firm ripe stage of maturity as at that point the flavor is best and the pectin and acid content is optimum for the fruit. Canned, frozen, or sulfured fruit may also be used. If the fruit used for preserving is canned or frozen, it is necessary to make allowances for any sugar that may be already added to the fruit, when calculating the quantities of ingredients being used. Sulfured fruits are sometimes used in making preserves. Sulfured fruits are prepared by covering the fruit with a brine of calcium carbonate and sulfur dioxide. The calcium salt firms the fruit and the sulfur dioxide prevents spoilage from occurring. When the fruit is used for preserves of any type the sulfur dioxide (about 2000 ppm. is removed by heating until less than 70 ppm. remains.

SUGAR:—The sugar used in making preserves of any type may be sucrose (cane or beet sugar) or a mixture of sucrose and dextrose (corn sugar). The proportion of sucrose to dextrose may vary with the fruit but, generally, 75% of sucrose and 25% of dextrose is used.

PECTIN:—A number of compounds occurring in plants, after boiling, have the property of solidifying into a gelatinous mass. Such a mass is commonly termed a "gel". In the juices of many fruits a gel-forming compound is found that is called pectin. Pectin, sugar, and acid are needed to form a gel but it is not definitely known how these components accomplish the solidification of a liquid. A generally accepted theory is that gel formation is due to a precipitation of the pectin in a concentrated sugar solution. The pectin is considered to be dispersed through the mass in countless tiny threads, crossing and recrossing in an unsystematic manner to form a sponge-like rigidity. The degree of firmness of a gel, in the food industry, is called "jell strength".

Pectin may be added to fruits or fruit juices for manufacture into preserves of any type without so stating on the label providing the pectin used is in a quantity which reasonably compensates for deficiency, if any, of the natural pectin content of the fruit ingredient. Pectin is available in dry or syrup form. It is produced commercially from plant sources by extracting, filtering, and concentrating. Pectin is located in the cell walls of fruits and as the fruit ripens water-insoluble protopectin is converted by the action of an enzyme into colloidal pectin. Slow cooking will also convert protopectin into colloidal pectin. When a fruit passes the stage of full maturity, colloidal pectin is converted to pectic acid and methyl alcohol. Pectic acid is relatively non-colloidal. The pectins, intermediate between insoluble protopectin and relatively non-colloidal pectic acid, are the ones that have the ability to form gels.

Pectin, whether dry or in syrup form, is graded according to its effectiveness in forming a gel. However, at the present time there is no uniform method used by the industry for grading pectins. A pound of pectin graded 100 is expected to gel 100 pounds of sugar to a standard jelly. A pound of pectin graded 40 is expected to gel 40 pounds of sugar to a standard jelly. The grade of a pectin is ordinarily important only in so far as the amount used is concerned. Commercial pectins may also be designated as slow or rapid setting depending on the length of time it takes for them to form a gel. Modified pectins, called low methoxyl pectins, are available that form gels with no sugar present.

ACID:—Vinegar, lemon juice, lime juice, citric acid, lactic acid, malic acid, tartaric acid, or any combination of two or more may be added to fruits or fruit juices for manufacture of preserves of any type without so labeling providing the

acid used is in a quantity which reasonably compensates for deficiency, if any, of the natural acidity of the fruit ingredient. Citric, tartaric, or malic are the acids usually used. Some preservers use the same acid for all fruits, other manufacturers use the acid which is most prevalent in the fruit being used. The effectiveness of the acid in gel formation depends on its active acidity (pH). The active acidity (pH) of the material to be gelled should be between 3.10 and 3.46 for best results. If the materials to be gelled are too acid, the finished product may "weep" which is a sign of syneresis. If the mixture is not sufficiently acid the gel may not form.

FINISH POINT:—The finish point for concentrating preserves of any type is important for satisfactory consistency. If the product is insufficiently concentrated, gelling will not occur and if the product is overconcentrated the consistency is rubbery. An optical instrument, the refractometer, which is usually calibrated to read directly in percent sugar, is an efficient instrument for determining the finish point. Only a few seconds and a drop of the liquid are necessary to make the test using this instrument. The temperature at which the fruit or fruit juice and sugar mixture boils also determines the percentage of soluble solids present and can be used as an index of the finish point. Since dextrose and invert sugar affect the boiling point to a greater extent than an equal weight of sucrose, it is necessary to standardize the boiling point against the desired sugar concentration for any particular formula. Another method is the drip method where an experienced operator dips up a ladle of the boiling material and determines the finish point by the way the material drips (sheets) from the edge of the ladle.

EQUIPMENT AND CONTAINERS:—The kettles used for cooking or concentrating the fruit or fruit juice mixtures are copper, aluminum, nickel alloy and stainless steel but much of the newer equipment is glass lined. Glass lined equipment is less likely to react with the food to impair the color or flavor of the finished product. Vacuum kettles are used in some cases in preference to open kettles as boiling occurs at a lower temperature under vacuum and the color and flavor of the finished product may be better.

Preserves of all types are filled immediately into the containers and mechanical filling machines are usually used. Glass jars or tin containers may be used and almost every conceivable size and shaped container is used.

Refractometry of Preserves and Syrups

The refractometer has long been indispensable in the manufacture of sugar syrups, and in recent years its use in tomato products and jams and jellies has been extensive. Present Federal specifications call for refractometric determination of solids in jams and jellies. In this connection, the writer has been asked to prepare a chart similar to ones published in 1926 and 1935 for tomato puree.

The index of refraction varies rapidly with temperature, requiring either that the instrument be held at constant temperature or that corrections for temperature be made. Tables of refractive indices of sugar (sucrose) solutions have been standardized for 28°C for the tropics and 20°C (68°F) for temperate climates, with accompanying temperature correction tables.

Control of temperature involves a flow of water of constant temperature, and, in the humid atmospheres met in most jam and jelly plants, may cause condensation on the prisms, preventing rapid reading. On the other hand, use of tables requires interpolation and temperature corrections which are either added or subtracted according to the direction of departure from standard temperature.

To eliminate the necessity for temperature control and decrease the possibility of arithmetical errors, the charts on pages 99 and 100 have been prepared, based on tables in the 1940 edition of "Official and Tentative Methods of Analysis" of the Association of Official Agricultural Chemists. Absolute conformity of chart to tables is impossible because the tables advance in irregular steps whereas the chart follows smooth lines closely approximating the steps of the tables. However, the maximum discrepancy found at a number of random points has not exceeded 0.07%, well within the ordinary requirements for factory operation.

Hot jam or jelly should be cooled rapidly by immersing the sample container, preferably metal, in cold water and stirring. If hot material is placed on the prisms, momentary evaporation may lead to readings higher than the true ones.

Suspended solids or air bubbles between the prisms will make the shadow indistinct. In such cases, replace carefully with a new sample drop after washing and drying the prisms. Washing and drying must always be gentle, using soft cloth or cleansing tissue to prevent scratching the glass.

If readings are taken from a sugar scale on the refractometer, temperature correction may be made from the chart, thus—

Find in "Solids" column the figure closest to observed sugar percentage. Follow its diagonal down to the 20° temperature line, thence along the nearest horizontal to the vertical line of temperature of the instrument, thence up nearest diagonal, and read off corrected solids. Directions given on the chart should require no amplification.

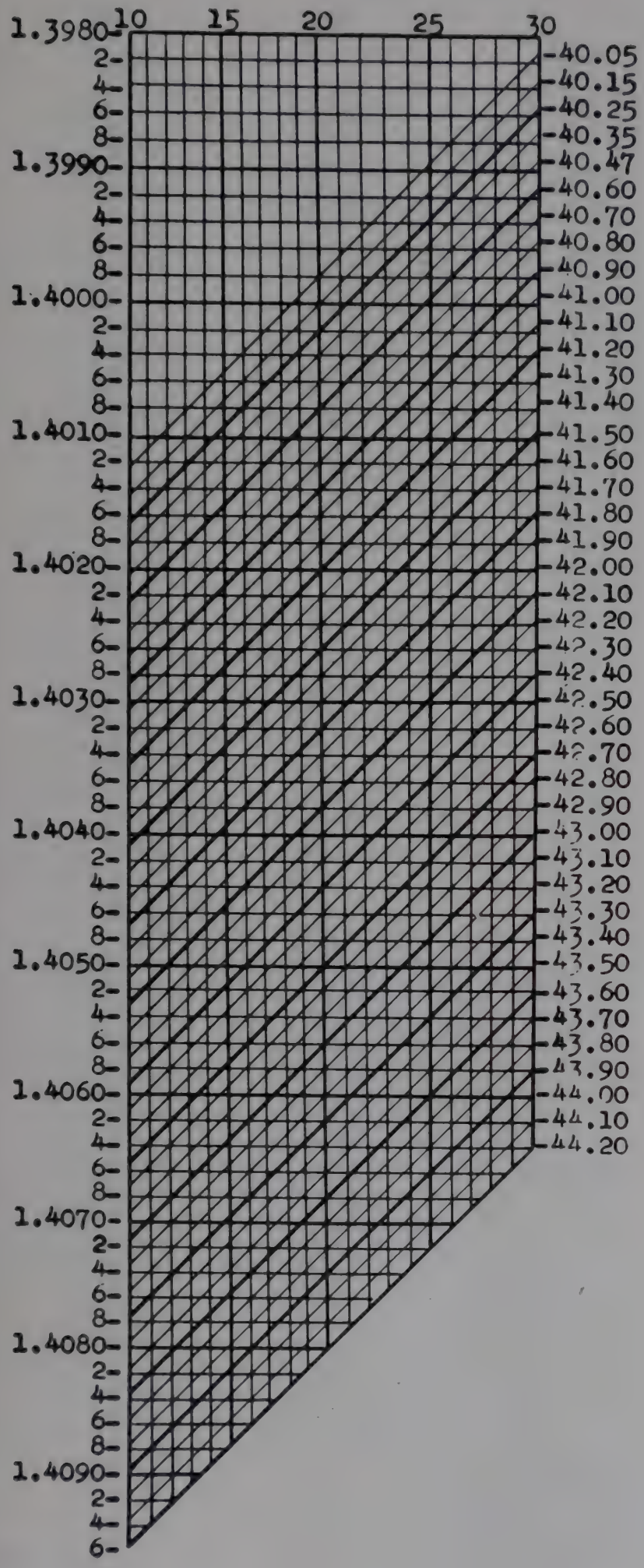
SUGAR SOLUTION INFORMATION (68° F.) = 20° C*

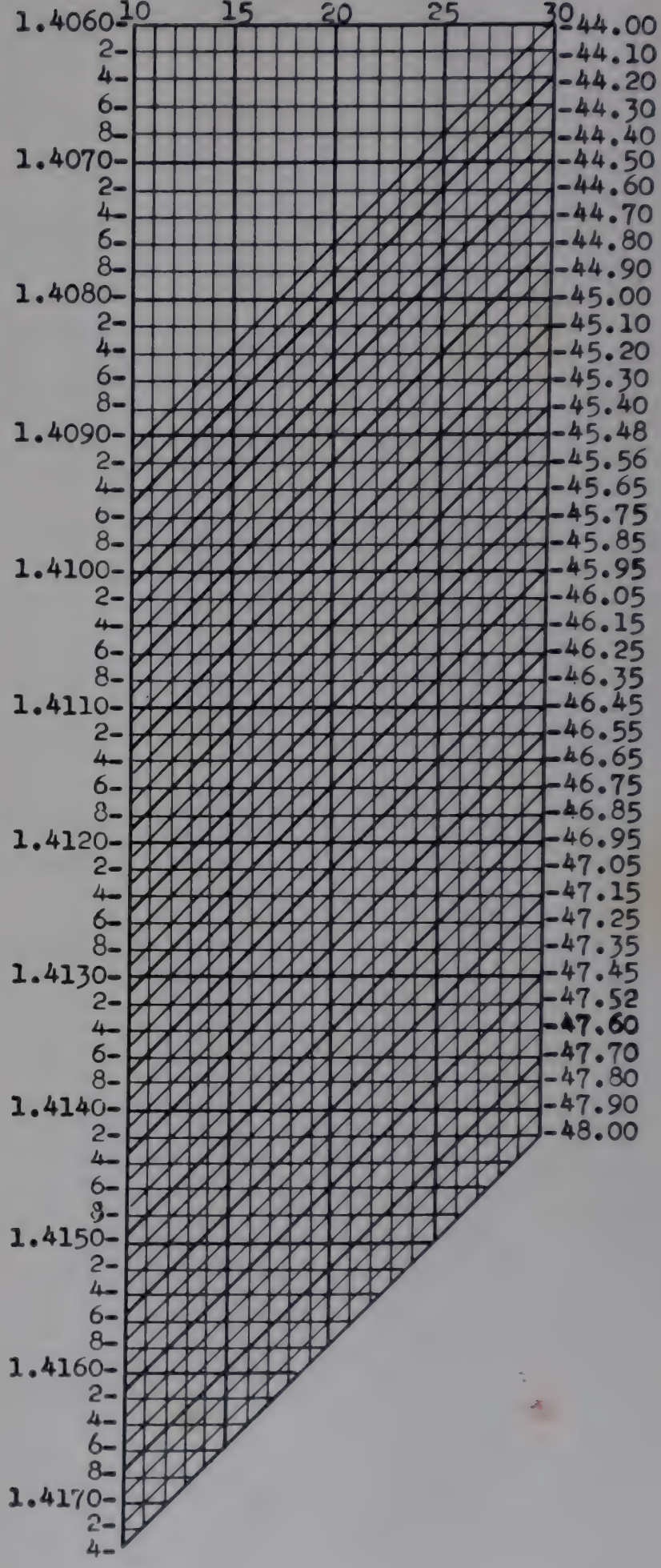
Sugar Solution	Amount of Sugar to Add to One Gallon of Water	Reading on Brix or Balling Hydrometer	Bureau of Standards Scale—Reading on Beaume Hydrometer 20/20	Refractive Indices	Weight per Gallon	
% by wt.	Lbs.	Degree	Degree		Lbs. at 20°C.	Lbs. at 27½°C.
0	0	0	0	1.3330	8.33	8.31
5	0.44	5	2.79	1.3403	8.49	8.47
10	0.93	10	5.57	1.3478	8.66	8.64
15	1.47	15	8.34	1.3557	8.83	8.81
20	2.08	20	11.10	1.3638	9.02	8.99
25	2.78	25	13.84	1.3723	9.21	9.18
30	3.57	30	16.57	1.3811	9.40	9.37
35	4.49	35	19.28	1.3902	9.61	9.57
40	5.55	40	21.97	1.3997	9.82	9.78
45	6.82	45	24.63	1.4096	10.05	10.00
50	8.33	50	27.28	1.4200	10.28	10.22
55	10.18	55	29.90	1.4307	10.53	10.46
60	12.50	60	32.49	1.4418	10.79	10.70
65	15.47	65	35.04	1.4532	11.06	10.95
70	19.44	70	37.56	1.4651	11.35	11.20
75	24.99	75	40.03	1.4774	11.65	11.47
80	33.32	80	42.47	1.4901	11.97	11.74

The following information was used in the above calculations:

1. Density of water at 20° C. = 0.99823 grams per ml.
2. 1000 ml. = 1 liter = 0.26417 gallons
3. 1 pound = 453.59 grams
4. Molecular weight of sucrose = 342
5. Volume occupied by one gram mole of sucrose dissolved in water at 20° C. = 212.5 ml.

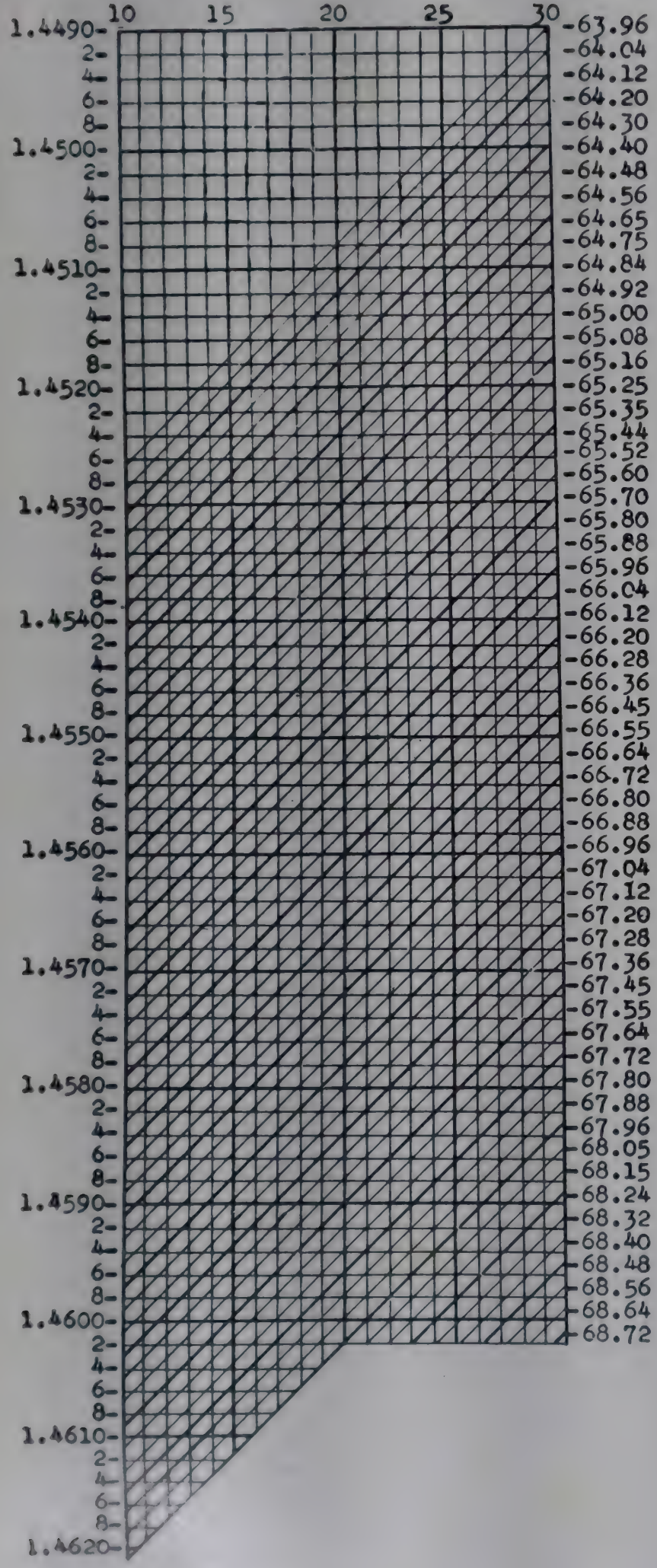
REFRACTIVE INDICES OF 40% TO 48% SUCROSE SOLUTIONS—10° TO 30°C.



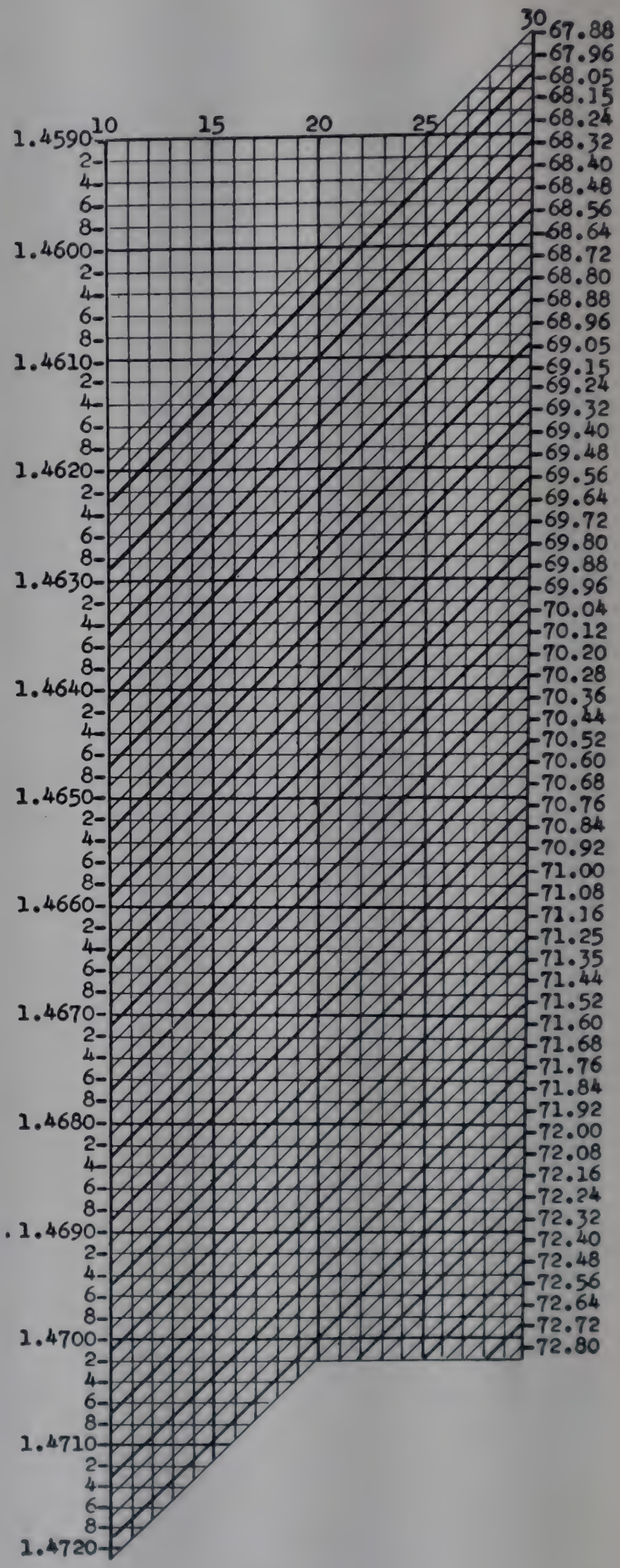


From Abbe refractometer (Index) reading at left, follow the horizontal line to right to the intersection with the vertical line corresponding to the temperature of the instrument. Then follow the nearest diagonal upward to right and read off solids at the end of the diagonal. This chart is based on tables in A. O. A. C. Methods of Analysis, 1940.

REFRACTIVE INDICES OF 64% TO 72% SUCROSE SOLUTIONS—10° TO 30° C.



Index Temperature 0°C. Solids



Index Temperature 0°C. Solids

From Abbe refractometer (Index) reading at left, follow the horizontal line to right to the intersection with the vertical line corresponding to the temperature of the instrument. Then follow the nearest diagonal upward to right and read the solids at the end of the diagonal. This chart is based on tables in A. O. A. C. Methods of Analysis, 1940.

Section 2—Preserving

Chapter II—Jellies

JELLY should be clear, transparent, and sparkling and when removed from its container should retain its original form, should quiver, but not flow. It should be gelatinous and not syrupy, gummy, or sticky and should retain as closely as possible the original aroma or flavor of the fruit. When cut, it should be tender yet still sufficiently firm that a sharp edge and smooth surface remains.

Jellies must contain not less than 45 parts, by weight, of fruit juice or juices to each 55 parts, by weight, of sugar. The jelly materials must be so concentrated that the finished product will have a sugar (soluble solids) content of not less than 65% as determined on a refractometer.

MANUFACTURING JELLY

WASHING:—The fruit is washed to remove dirt, leaves, and any spray residue present. Delicate fruits, such as berries, are washed either by running water which carries the fruit over baffles, or gentle sprays of water as the fruit is rolled along a shaker-grader. With hard fruits, a rougher treatment is more efficient and pressure sprays can be used. If the skins of the fruits are to be used with the pulp in making jelly, the spray residue must be removed. To remove the spray residue the fruit is usually washed in a solution of 0.1% hydrochloric acid.

PEELING, TRIMMING, AND CORING:—Some berry fruits must be capped, i.e., the stem and calyx removed. Other fruits require peeling and coring, and stone fruits must be pitted. Peeling may be accomplished by mechanical means or by treatment in a lye bath. Automatic machines are available for these operations.

EXTRACTING:—After washing, fruits for jelly making are boiled to obtain the maximum yield of juice, pectin, and other extractives. Boiling softens the fruit tissues and converts protopectin into colloidal pectin. Because boiling may cause a loss of flavor, the length of the boiling period is limited to that time necessary for thorough extraction of the fruit and this requirement varies with the fruit. Citrus fruits may require boiling for an hour, apples for 20 minutes, berries for two minutes. The amount of water used with the fruit during boiling depends upon the fruit. Citrus fruits, due to the long period of boiling, may require the addition of two or three parts of water to one part of fruit, apples may require an equal volume of water, and berries may need no added water. Some jelly manufacturers boil the fruit a second time with fresh water to obtain a maximum extraction from the fruit. The first and second extractions are then mixed and concentrated to a standard volume by the processor.

PRESSING:—The juice is separated from the fruit pulp by means of a press. The rack and cloth press is the most common of the several types of presses in use. In the rack and cloth press, the boiled and crushed fruit is placed in heavy, coarsely woven, cotton cloths. Sufficient fruit is placed in the cloth so that, when the edges are folded over the center, it forms a square about three inches thick. The cloths of fruit pulp are placed in the press frame, and a wooden rack, made of heavy slats of hardwood, is placed between each two cloths. The stack of cloths and racks is termed a "cheese". Mechanical pressure is applied to the cheese by a screw or a hydraulic plunger until the juice is expressed. The pressure is applied gradually to prevent bursting of the cloths and to prevent the passage of particles of pulp with the juice.

CLARIFYING:—There are three general methods of clarifying the juice, namely; centrifuging, filtering, and enzymatic. Centrifuging is accomplished by a piece of machinery. Filtering may be accomplished by using standard filtering equipment or simple bag filters. Filter aids such as infusorial earth (diatomaceous silica) are used to prevent clogging of the filtering cloths or bags. Some jelly manufacturers use an enzyme such as pectinol to coagulate the colloidal constituents of the juice. Because the enzyme pectinol removes pectin from the juice it is necessary to add pectin to the juice prior to making jelly.

MIXING:—The pectin and acid, if necessary, and the sugar are usually added to the fruit juice prior to boiling, if the jelly is to be made in a vacuum evaporator. To prevent lumping of dry pectin, when it is added, it should be mixed with the sugar and then stirred into the juice. If an open kettle is used for concentrating, flavor and color may be preserved in the product by postponing the addition of sugar and pectin until part of the excess water has been removed from the juice. If additional acid is necessary for making a jelly it is usually added just before the product reaches the finish point. The reason for delaying the addition of acid is to prevent the acid from completely changing the colloidal pectin to relatively non-colloidal pectic acid.

CONCENTRATING:—The concentrating of the jelly mixture to its finish point usually should be as rapid as possible to reduce losses in flavor and color and to inhibit changes in the pectin content.

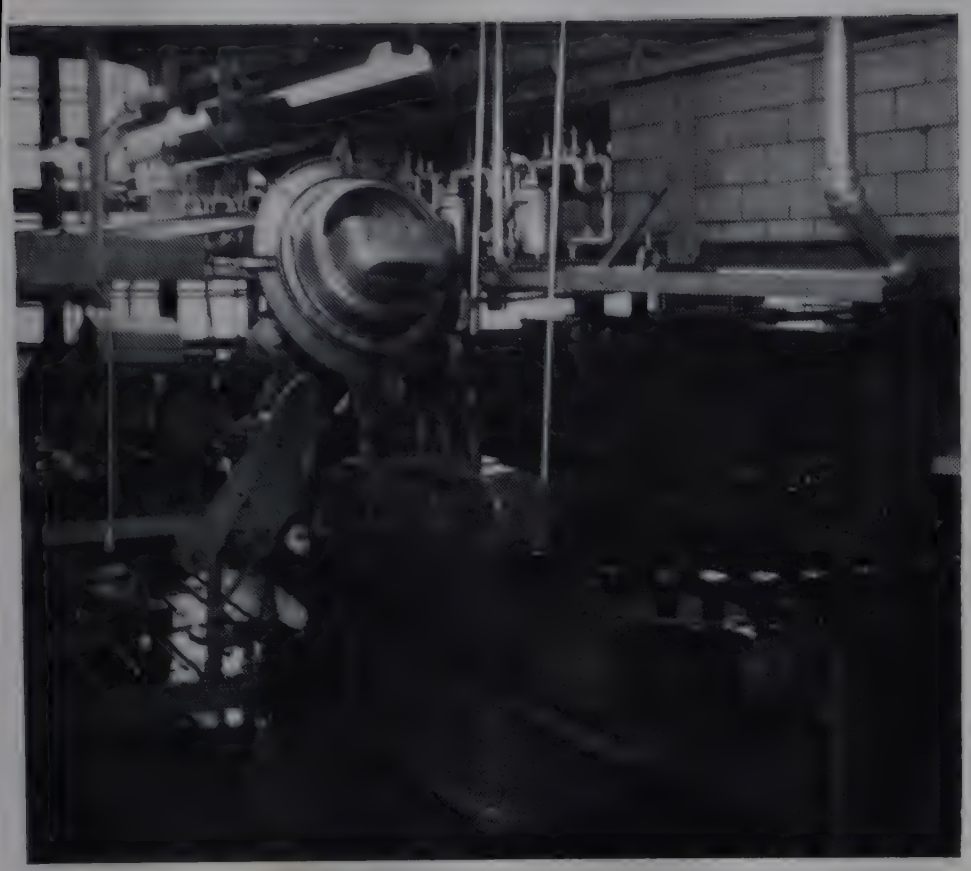
FILLING is accomplished as rapidly as possible so that the jelly solidifies in the container and not in the kettle or filling machine.

SEALING:—Glass containers are usually sealed under vacuum to prevent mold from forming on the surface of the jelly. Tin containers may be sealed under vacuum or without vacuum. If the cans are sealed without vacuum the sealed container is usually given an immediate processing for two or three minutes in boiling water to destroy or inactivate any molds that may be on the surface of the jelly.

PURE FRUIT JELLY

Pure fruit jellies are made from sugar and the juice of fruits or a mixture of fruit juices. Pectin and acid may be added in a quantity which reasonably compensates for deficiency, if any, of the natural pectin and acid content of the fruit juice ingredient.

APPLE:—Wash the apples, cover with water (approximately one and one-half pound of water to a pound of fruit), and cook until the fruit is broken down to a pulpy mass. The juice is then pressed out and clarified. (For each lot of extracted juice it is desirable to prepare small quantity test batches using varying amounts of sugar so that a standard



Processed jam is piped from kettles to these fillers in modern preserving plant. After vacuum capping, the jars go to cooler.

formula may be established for the remainder of the juice. Usually each test batch consists of one pound of juice and the sugar variation is one pound, three quarters of a pound, and one-half pound). Add the required amount of sugar to the extracted juice and concentrate to 65% soluble solids as determined by a refractometer, fill the product into containers, and seal.

CRANBERRY:—Although the finished sauce made from cranberries is not a clarified product and it does contain pulp particles, the procedure for manufacture is comparable to that of a jelly. Wash the fruit, cover with water, and cook to a pulpy mass. Pass through a pulping machine to remove the skins and seeds, add sugar, concentrate to the finish point, fill into containers, and seal.

CURRANT:—Wash, it is not necessary to remove the stems, cover with water, and cook until the fruit is soft. Prolonged cooking removes excessive quantities of tannin from the stems and imparts an undesirable astringency to the finished product. Strain the juice, filter, add the sugar, concentrate to the finish point, fill into containers, and seal.

GRAPE:—Wash, remove stems, add water to cover or crush a few grapes to release some juice, cook until the fruit is soft, and press out the juice. Grapes contain cream of tartar (potassium bitartrate) in varying quantities and unless removed from the juice may form crystals in the finished jelly. These crystals result in an undesirable texture for the jelly. Some preservers use calcium carbonate (chalk) to aid in precipitating the tartrates and other preservers store the juice in glass carboys until the tartrates settle out. If the extracted juice is stored it is necessary to pasteurize it to prevent spoilage. Filter, add sugar, concentrate to the finish point, fill into containers, and seal.

QUINCE:—Wash, slice, cover with water, cook until fruit is a pulpy mass, press out the juice, and clarify. A brighter color of jelly is produced from quince juice if the extracted juice is heated, without concentrating, prior to adding the sugar. Add sugar, concentrate to the finish point, fill into containers, and seal.

APPLE—FRUIT JELLY

As pectin fruits are low in natural pectin or acid it is necessary to add apple or other fruit juices for the source of pectin and/or acid. Such jellies must be so labeled, for example, "Apple-(Other Fruit) Jelly."

Apple—Currant

Apple juice	22 gallons
Currant juice	4½ gallons
Sugar	65 pounds

Apple—Mint

Apple juice	8 gallons
Sugar	80 pounds
Mint flavor	2 ounces
Green color	4 ounces

Apple—Raspberry

Apple juice	22 gallons
Raspberry juice	4½gallons
Sugar	65 pounds

Apple—Strawberry

Apple juice	22 gallons
Strawberry juice	4½ gallons
Sugar	65 pounds

PECTIN - FRUIT JELLY:—Powdered or liquid pectin and acid may be added to the fruit juice in excess of a quantity which reasonably compensates for any deficiency of the fruit juice ingredient. If an excess of pectin and acid is used, the finished product must be so labeled and the statement is usually made "(Fruit) Jelly with Added Pectin." Formulas for making pectin-fruit jelly are available from pectin manufacturers. Honey and wine jellies are usually manufactured with added pectin.

IMITATION FRUIT JELLY:—Imitation fruit jelly is usually composed of pectin, sugar, artificial color and flavor, corn syrup, and acid. Some fruit juice may be included for flavor. Jelly thus made must be labeled. "Imitation Fruit Jelly" and the ingredients used must be listed. Formulas for making imitation fruit jelly are available from pectin manufacturers.

"LOW METHOXYL" PECTIN JELLY:—This jelly may be used for preparing fruits in jelly or other desserts having a low sugar content. A suggested formula is:

Sugar	40.00%
Pectin—320 (400°)	1.12%
Sodium citrate	0.20%
Tricalcium phosphate	0.25%
Citric acid	0.50%
Water	57.93%

Heat the water, stir in all ingredients except the tricalcium phosphate. When the mixture boils add the tricalcium phosphate. Fill and seal.

GELATIN JELLY:—By the use of gelatin, a jelly can be formed that has a low sugar content. The quantity of sugar may be regulated to suit the taste. Fruit juice, gelatin, citric acid, sugar, and water are used to make gelatin jellies.

Calf's Foot

Gelatin	2 pounds
Water	64 pounds
Citric acid	1 pound
Wine	10 pounds
Sugar	23 pounds

Mix the gelatin with a small quantity of water. Heat the remainder of the water and sugar and acid together to dissolve the sugar. Add the gelatin and dissolve. Add the wine. Heat to 180° F. Fill into containers, cap, and pasteurize at 180° F. for 20 minutes.

AGAR JELLY:—Jelly without any added sugar may be manufactured by using fruit juice, water, and agar. A suggested formula is:

Fruit juice	100 pounds
Water	12 gallons
Agar	3 pounds

Dissolve the agar in a small quantity of water, add to the fruit juice and water, bring to a boil, fill into containers, seal, and pasteurize at 180° F. for 20 minutes.

RECOMMENDED FILL OF CONTAINER:—The container should be filled with jelly as full as practicable without impairment of quality and the product should occupy not less than 90% of the capacity of the container.

Chapter III—Jams and Preserves

FOOD and Drug Administration regulations and Standards of Identity do not differentiate between preserves, jams, marmalades, and butters. However, common usage usually identifies preserves as having pieces of fruit larger than those in jams.

Preserves or jams are viscous or semi-solid foods made from a mixture composed of not less than 45 parts, by weight, of fruit to each 55 parts, by weight, of sugar. The mixture must be so concentrated that the finished product will have a sugar (soluble solids) content, as determined on a refractometer, of:

1. Not less than 68% for blackberry, black raspberry, blueberry, boysenberry, cherry, crabapple, dewberry, elderberry, grape, grapefruit, huckleberry, loganberry, orange, pineapple, raspberry, red raspberry, rhubarb, strawberry, tangerine, tomato, yellow tomato, and youngberry.

2. Not less than 65% for apple, apricot, cranberry, damson plum, fig, gooseberry, green gage plum, guava, nectarines, peach (clingstone and freestone), pear, plum, quince, and currant.

MANUFACTURING JAM OR PRESERVES

Jam and preserves are prepared in a similar manner to jelly except that the fruit itself, rather than the extracted juice, is used as the basic ingredient.

Washing, peeling, trimming, coring, and mixing are accomplished in the same manner and for the same reasons as described in jelly manufacture.

CONCENTRATING:—Both the open kettle and the vacuum evaporator are used for concentrating jam and preserves to the finish point. In open kettle cooking, high temperatures are reached and there is a danger of scorching the fruit and loss of flavor and color. The open kettle method does not produce as attractive a product particularly in the case of delicate fruits such as berries because at the higher temperatures the fruits disintegrate more readily. When the vacuum evaporator method of cooking is used, the moisture is driven off at lower temperatures. By this method, alternating between a vacuum and a slight pressure during the cooking, an even penetration of the syrup into the fruit is accomplished. It is possible to cook such delicate fruits as strawberries in a vacuum evaporator and have 50-60% of the berries remain whole and plump in the finished product. The finish point is determined by the methods described in jelly manufacture.

FILLING:—The filling operation is usually done by automatic fillers. However, hand filling may be desired for some delicately textured fruits because more care can be employed to eliminate crushing and breaking the fruit. The cooked product is run into shallow pans and then dipped, by means of small dippers, and poured into the cans or jars.

SEALING:—The containers are usually sealed the same as described in jelly manufacture.

COOLING:—To conserve color and flavor, jams and preserves should be cooled as rapidly as possible after sealing. Cooling is usually accomplished by conveying the containers under sprays of cold water. If the containers are glass, the water first striking the sealed jars should be partially warmed in order to prevent breakage. Another series of sprays of colder water can follow the initial cooling.

PURE FRUIT JAM AND PRESERVES

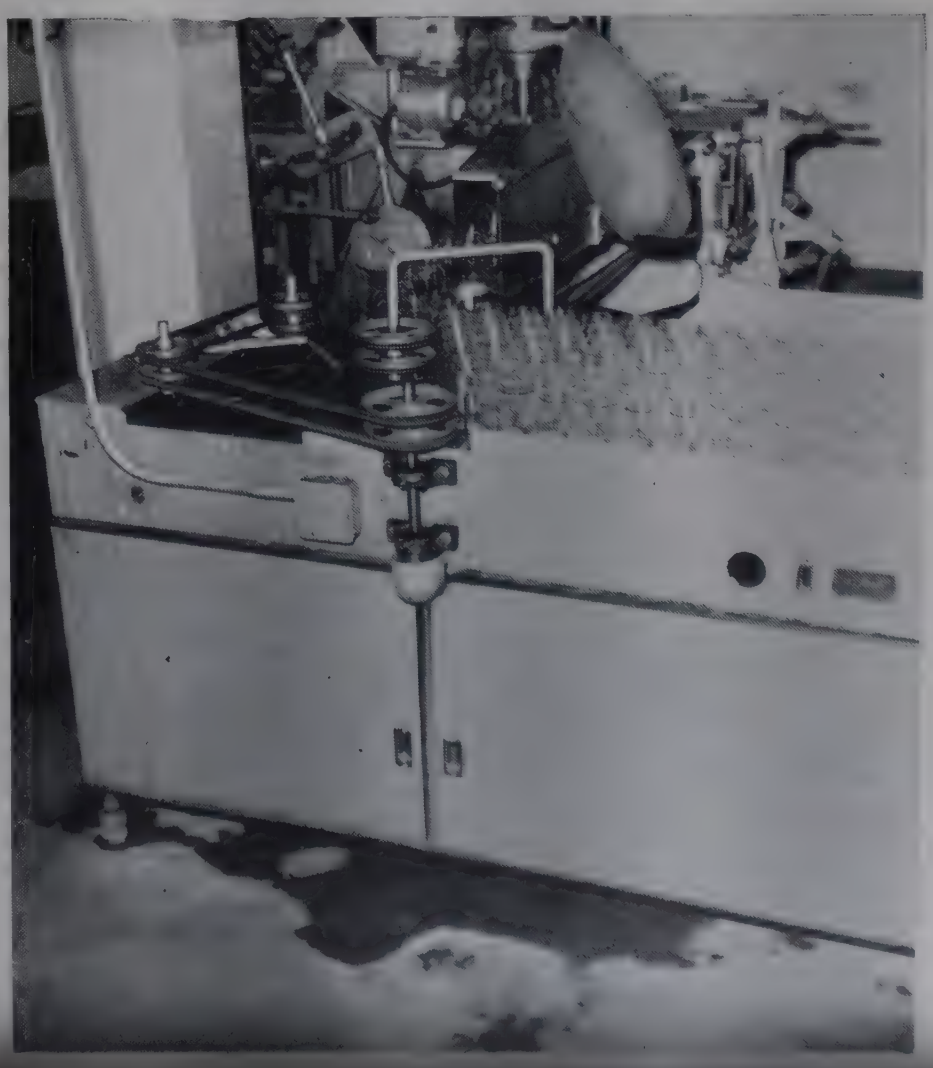
Pure fruit jams and preserves are made from sugar and fruit or a mixture of fruits. Pectin and acid may be added in a quantity which reasonably compensates for deficiency, if any, of the natural pectin and acid content of the fruit juice ingredient.

APRICOT PRESERVE:—This preserve is usually made with the skins left on as the peeled fruit will not stand up under cooking but will disintegrate and be more like a fruit butter. The pit or seed is removed, the fruit blanched for a few minutes, until soft. Fifty pounds of fruit, 50 pounds of sugar, and one gallon of water are used. The sugar and water are brought to a boil and the fruit is then added. The mixture is boiled until the desired concentration of 65% soluble solids is reached. Fill into the containers, seal, pasteurize for 20 minutes at 180° F., and cool.

CRANBERRY SAUCE (WHOLE):—The berries are washed and boiled in water until the skins crack. The water is drained off and a 60% sugar solution is added and the mixture is concentrated to the desired finish point of 65% soluble solids. Fill into the containers, seal, pasteurize for 20 minutes at 180° F., and cool.

PEACH PRESERVE:—Fifty pounds of sugar and two

Straight-line unscrambling table handles glass containers at high speed from upturned cartons; needs only one operator.



This machine mixes whole strawberries and sugar for preserving. Device is designed to mix ingredients without crushing.

gallons of water are brought to a boil and 50 pounds of peeled and pitted peaches are added. Concentrate to the desired finish point of 65% soluble solids. Fill into the containers, seal, pasteurize for 20 minutes at 180° F., and cool.

RASPBERRY JAM:—Fifty pounds of sugar and fifty pounds of slightly crushed raspberries are mixed together and concentrated to the desired finish point of 68% soluble solids. Fill into the containers, seal and pasteurize for 20 minutes at 180° F., and cool.

STRAWBERRY PRESERVE:—Heat 50 pounds of strawberries, 50 pounds of sugar and 1 quart of water to 180° F. in an open kettle and then draw into a vacuum evaporator. Boil until the desired concentration of 68% soluble solids is reached. During the cooking, an 18 inch vacuum is maintained for two minutes and then released and a slight steam pressure is maintained for one minute. This cycle is repeated until the concentrating process is completed.

Sun-cooked preserve is made by bringing the mixture of strawberries, sugar, and water to a boil in an open kettle. The mixture is then poured into shallow pans (about two inches in depth), the pans are then covered with cheesecloth and placed in direct sunlight until evaporation has concentrated the mixture to 68% soluble solids. The fruit takes up the syrup, becomes firm and plump, and retains nearly all the natural color and flavor. Then fill the vacuum evaporated or the sun-cooked preserve into the containers, seal, pasteurize for 20 minutes at 180° F., and cool.

STRAWBERRY JAM is made by the same procedure as strawberry preserve except that the concentrating is accomplished in an open kettle. The boiling temperature of the mixture in the open kettle usually results in some breaking up of the fruit.

APPLE—FRUIT JAM AND PRESERVE

As some fruits are low in natural pectin or acid it is necessary to add apple juice or pulp for the source of pectin and/or acid. Such jams or preserves must be so labeled, for example, Apple-Raspberry (or other fruit) Jam (Preserve). The procedure usually used is to cook the fruit and part of the sugar together to the finish point and then mix with the apple pulp or juice and the remaining sugar that has been concentrated to the desired finish point. The mixture is cooled until the fruit does not float, filled into containers, sealed, pasteurized for 20 minutes at 180° F., and cooled.

Apple pulp	50 pounds
Sugar	100 pounds
Fruit	50 pounds

PECTIN - FRUIT JAM AND PRESERVES:—Powdered or liquid pectin and acid may be added to the fruit in excess of a quantity which reasonably compensates for any deficiency of the fruit ingredient. If an excess of pectin and acid is used, the finished product must be so labeled and the statement is usually made "(Fruit) Jam (Preserve) with Added Pectin." Formulas for making pectin—fruit jam and preserves are available from pectin manufacturers.

IMITATION FRUIT JAM AND PRESERVES:—Imitation fruit jam and preserves are usually composed of pectin, sugar, artificial color and flavor, corn syrup, and acid. Some fruit may be added for appearance and flavor. Jam and preserves made in this manner must be so labeled. Formulas for making imitation fruit jam and preserves are available from pectin manufacturers.

RECOMMENDED FILL OF CONTAINER:—The container should be filled with jam or preserve as full as practicable without impairment of quality and the product should occupy not less than 90% of the capacity of the container.

In photo below, peaches are being inspected, then filled into large containers for freezing and later use in preserves.

Here, in a fruit freezing plant, strawberries are carefully inspected. Quick frozen fruit is widely used for preserving.

Chapter IV—Butters and Marmalades

THE TERM butter usually refers to a semi-solid paste made by cooking strained pulp of a fruit or a mixture of fruits that has been concentrated to a sugar (soluble solids) content, as determined by a refractometer, of not less than 65 or 68% depending on the fruit used.

The term marmalade usually refers to a citrus fruit jelly in which sliced or chopped portions of the skins are embedded or suspended. The mixture has a sugar (soluble solids) content, as determined by a refractometer, of not less than 65 or 68% depending on the fruit used.

The soluble solids concentration for butters and marmalades is dependent on the type of fruit used and the list of fruits for each concentration is the same as the list for jams and preserves.

Butters and marmalades must contain not less than 45 parts, by weight, of fruit to each 55 parts, by weight, of sugar. Pectin and acid may be added in a quantity which reasonably compensates for deficiency, if any, of the natural pectin and acid content of the fruit ingredient.

MANUFACTURING MARMALADES

Marmalades are manufactured in the same manner as jams, preserves, and butters except that the skins of the citrus fruits are added. These skins have to be removed from the fruit and softened by cooking prior to adding to the fruit pulp and the sugar.

English Seville Orange

Seville orange pulp and juice	40 lbs.
Seville orange peel	4 lbs.
Sugar	40 lbs.

Ginger

Ginger	50 lbs.
Citrus pulp	65 lbs.
Ginger syrup	21 lbs.
Sugar	63 lbs.

American Orange

American orange pulp and juice	1 gal.
American orange peel	1 gal.
Sugar	12 lbs.

Tangerine

Tangerine pulp	80 lbs.
Tangerine peel	4 lbs.
Sugar	52 lbs.

Grapefruit

Grapefruit pulp	8 gals.
Grapefruit peel	4 lbs.
Sugar	60 lbs.

Lemon

Lemon pulp	80 lbs.
Lemon peel	4 lbs.
Sugar	80 lbs.

PEELING:—If the citrus fruit is hand peeled, it is usually placed in boiling water for about three minutes to loosen the skin. Following this treatment the peel is split from end to end and removed. Oranges and other citrus fruits are often peeled by mechanical methods.

TREATING:—After the fruit has been peeled, it is chopped or shredded. Following this the peel is cooked until soft.

The pulp and juice from the fruit is separated from the seeds and other wastes. The pulp may be strained or put through a cyclone pulper to make a uniform textured product.

MANUFACTURING BUTTERS

For butters, the fruit is cooked with a small amount of water until it becomes a pulp mass. It is then run through a cyclone finisher to break the pulp into uniform texture The strained pulp is mixed with approximately an equal quantity of sugar. Sometimes boiled cider, fresh cider concentrated four parts to one, is added. The mixture is concentrated to the desired finish point. Approximately ten minutes before the cooking is completed the spices are added. The product is then handled the same as a jam or preserve.

Apple

Fresh apples	325 lbs.
Sugar	100 lbs.
Boiled cider	4 gals.
Cinnamon	1 lb.

Peach

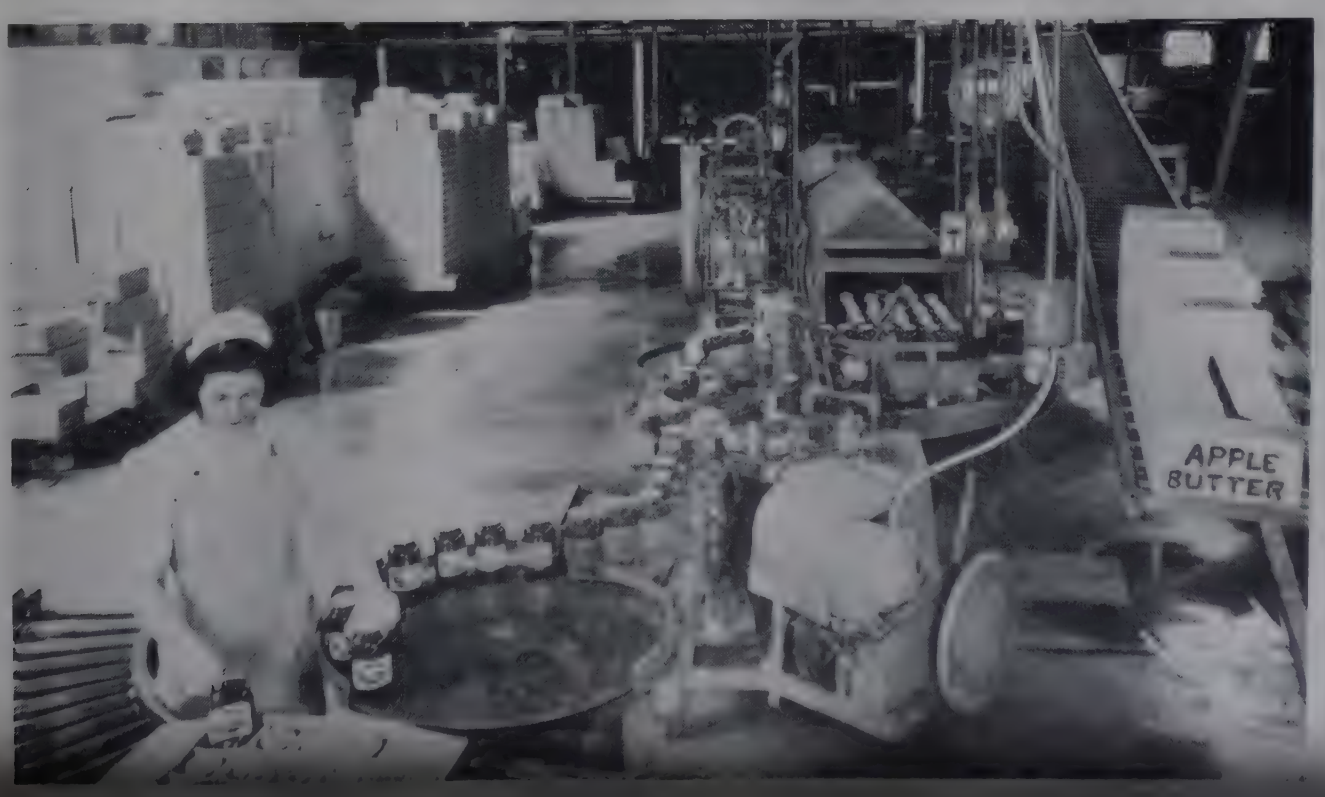
Peach pulp	50 gals.
Sugar	60 lbs.
Boiled cider	10 lbs.
Spices	As desired

Apricot

Apricot pulp	50 gals.
Sugar	65 lbs.
Spices	As desired

Prune

Prune pulp	120 gals.
Sugar	125 lbs.
Cloves	1 lb.
Cinnamon	1 lb.



Section 2— Preserving

Chapter V—Crushed and Glace Fruits

THIS particular class of products is used for ice cream sundaes, sodas, etc., and is usually packed in half-gallon jars. They may be used by mixing one part of the crushed fruit or syrup with three to four parts of plain syrup. This is then poured over the ice cream or used in sodas.

Crushed fruit as known to the soda fountain trade is nothing more than fruit jam with benzoate of soda and perhaps certified coal tar color. As the fruit is subjected to frequent opening and infection of mold, it is almost necessary to use a preservative even though the product may be pasteurized. The finished product must withstand all sort of climatic changes and handlings without molding or fermenting. The product is often kept for weeks either in an ice box or in a warm room, and perhaps a contaminated spoon that has been used in some other fruit or ice cream may be used to remove part of the fruit from the original package and mix the fruit with the syrup.

Crushed fruits are made from fresh, canned, or frozen fruits by using the same equipment that is used for jam. Fresh fruits naturally make the best flavored products and frozen the next. Canned fruits, having been given a preliminary cooking before processing, lose some of the fine flavor, aroma and color.

CRUSHED FRUIT IN VACUUM PAN:—This method produces a greater yield of crushed fruit without the surplus syrup that usually results when cold packed fruits are used. Vacuum system will preserve the color, flavor, and aroma of the fruit, without disintegrating, as they may be cooked at about 140 to 150° F., whereas the temperature of open kettles may be from 218-220° F. Cold pack fruits, upon standing, will separate about 50/50 and after thawing, the syrup is drawn into the pan and concentrated to the proper consistency. In the meantime the fruit is slowly heated in kettles with the proper amount of sugar to 180° F. This causes a further separation of the juice which is also drawn into the pan and concentrated. The fruit may in whole or in part be drawn into the pan and finished. Should only part of the fruit be drawn in at first, then the balance can be added later. The vacuum is broken and the product heated to 180° F. before filling, as this is above the thermal death point of yeast and may prevent spoilage. The fruit is very small when frozen but when subjected to the vacuum, it swells to almost its normal size.

STRAWBERRIES FROM FRESH FRUIT (METHOD A):—Only firm ripe fruits of the good red color are used. The necessary washing and sorting precautions having been taken, it is then placed in a kettle using equal parts of fruit and sugar. Heat slowly and stir gently to prevent breaking the fruit. Boil about four minutes, empty into a cooling pan that can be cooled quickly. After the fruit absorbs the sugar syrup and no longer floats, fill into jars, cap and process at 180° F. for 30 minutes, after the water reaches this temperature. If steam is used in processing, take one hour to complete the operation, 15 minutes to raise the temperature, 30 minutes for sterilization, and 15 minutes to cool the retort before opening.

Calculate the amount of benzoate necessary per finished batch, dissolve it in a small amount of syrup or water and see

proximately 11 pounds per gallon and require about 1¾ ounces of benzoate per ten gallons of finished fruit.

METHOD B:—The fruit and sugar are slowly brought to a boil, then emptied into cooling pans and allowed to remain until the berries will take up the sugar. If possible, the fruit should remain in the syrup over night. Separate the berries and juice and after adding the proper amount of benzoate pack into jars and process for 30 minutes at 180° F. Time and equipment may not permit this long a procedure; if not, they should be allowed to remain several hours. It is the practice among some to bring to a boil and separate the fruit and juice, then pack the fruit in jars and process, and concentrate the juice to 65° Brix for fountain syrup. To this separated syrup, sugar may be added and heated to 190° F. with benzoate of soda. Fill in jugs or glass without processing.

Use 8 gallons separated fruit juice
56 pounds sugar
2⅛ ounces benzoate
Cook to 190° F.

By this very light cook, the fruit retains its natural freshness. Weigh the fruit, calculate the proper amount of benzoate to be added; dissolve it in a small amount of the strawberry syrup and incorporate thoroughly. Do the same with the finished syrup. As a 65° Brix syrup weighs 11 pounds per gallon, add 1¾ ounces of benzoate per ten gallons.

STRAWBERRIES FROM COLD PACK:—Cold pack fruit makes a very finely flavored crushed fruit, but the fruit may also break up when cooked. As most of the cold pack for soda fountains is put up with equal parts of fruit and sugar, in cooking no additional sugar is necessary. As the cold pack upon standing will separate, a spigot can be placed near the bottom of the barrel, head removed, the syrup drawn off, the berries removed, remixed in the proper proportion, and cooked slowly to 218° F. If cold pack fruit when removed from the barrel has contracted and appears to be one-half to one-third natural size, upon cooking it will swell greatly. If cooked too rapidly, the fruit bursts and the finished product has a pulpy appearance. It may also be necessary to add certified color to cold pack fruits because freezing partly destroys the natural color. Calculate and add the proper amount of benzoate.

Crushed Strawberries Made From Cold Pack Fruit

Fruit and juice	440 pounds
Sugar	450 pounds
Benzoate of soda	1 pound
Strawberry liquid color*	20 ounces

Cook to 222 degrees F.
Produced—5 dozen ½-gallon glass jars.
2 only 5-gallon wooden pails.
35 gallons bulk crushed fruit.
Total yield of 75 gallons.
Weight one gallon, 12 pounds.

***Strawberry Liquid Red Color**

Amaranth (powdered)	2¼ ounces
Ponceau (powdered)	1 ounce
Water to make	1 gallon

The separated syrup is often heated with sugar, benzoate of soda, and strawberry color to 190° F., filled into containers hot and sold as fountain syrup. This makes a syrup with a wonderful flavor as the fresh odor and flavor have not been driven off by high temperature.

Strawberry Fountain Syrup

Strawberry juice, drained from cold packed fruit	30 gallons
Sugar	250 pounds
Strawberry liquid red color	25 ounces
Benzoate of soda	8¾ ounces
Produced	48 gallons

The fruit remaining is then cooked with sugar, the proper amount of benzoate of soda added and cooked to 220-221° F. and filled into jars. As the syrup and crushed fruit may be too sweet it often requires the addition of citric acid to counteract this and prevent crystallization of the sugar. This general procedure also applies to raspberries and other fruits.

Raspberry: From Cans

18 cans of black raspberries drained
75 pounds of sugar
3 ounces of benzoate
Cook to 200° F.
Cool to about 160° F.
Fill and cap.
Produced 31 half gallon jars.

Juice Separated From Above

2½ gallons juice
5 pounds sugar
1 ounce benzoate of soda
Cook to 190° F.
Produced 4 gallons of syrup.

STRAWBERRIES FROM CANNED BERRIES:—In using canned stock, the raw material should not have been packed too long as strawberries and some other fruits lose their color and have a poor appearance which requires the use of artificial color. No matter how careful one handles strawberries from cans, the finished product presents the appearance of a jam. The fruit having been processed in the can is soft to start with and the high temperature necessary in cooking helps to break the berries. To each No. 10 tin of berries use 4 pounds of sugar and cook 218° F. Use the necessary amounts of benzoate. Cool until the berries do not float, then fill, cap, and process for 30 minutes at 180° F. It is often necessary to use certified color which must be stated on the label as well as the benzoate of soda used.

PINEAPPLE:—For the small manufacturer, it is better to use number ten tins of crushed pineapple than the fresh fruit. If the fresh fruit is cheaper and more abundant, then by all means use it. Where the production is small, canned pineapple can be used more economically. Crushed pineapple in syrup gives the best results.

As pineapple is firm it will require more cooking to properly prepare it for use. Instead of boiling for about four minutes, the fresh pineapple should be cooked to 218-220°. Cook, fill, and sterilize for 30 minutes at 180° F.

CRUSHED FRUIT FROM CANNED PINEAPPLE:—To obtain a product that retains a good fruit flavor and color, it should be cooked as low as possible. By separating the fruit and juice and cooking both separately with sugar, crushed fruit as well as syrup can be obtained. Strain the canned fruit through a sieve and to the pulp from 18 No. 10 tins of pineapple add 75 pounds of sugar, 3 ounces benzoate of soda, cook slowly to 190° F. only. Mix well, fill hot, but stir constantly while removing from the kettle to prevent too great a separation. Cap. It is not necessary to pasteurize.

18 cans No. 10 pineapple in syrup
75 pounds of sugar
3 ounces benzoate
Produced 30 to 31 one-half gallon jars.

The separated juice can be cooked with sugar and benzoate to produce a finely flavored pineapple syrup.

8 gallons strained juice
56 pounds sugar
2⅛ ounces benzoate of soda
Produced 12 gallons syrup.

PINEAPPLE-GRAPE:—Can be made by adding 8 ounces concentrated true fruit grape flavor to 5 gallons of finished pineapple, or by adding about 1 quart of grape juice.

PINEAPPLE-ORANGE:—By using a small amount of bitter orange with pineapple a product can be made for sundaes or for making a special ice cream.

12 No. 10 tins pineapple—drain off the juice
3 gallons Seville oranges—shredded and packed in water in tins (drained)
62 pounds of sugar
2¼ ounces benzoate of soda
2 ounces liquid orange color (color made by dissolving 1 ounce orange in 1 quart of distilled water)
2½-ounces citric acid
Cook to 190° F.

Cool to prevent separation and add the color just before filling. Produced 144 pounds net.

A cheaper crushed fruit can be made by using part corn syrup with the addition of gelatine or agar-agar for a thickener. A 1% gelatine should produce a firm jelly.

Strawberry:	Number 1	Number 2
No. 10 tin strawberries	9 cans	9 cans
Sugar	35 pounds	65 pounds
Corn syrup	25 pounds	..
Benzoate	2 ounces	2 ounces
Liquid red color	4 ounces	4 ounces
Agar-agar	..	21 ounces
Cook to	195° F.	195° F.
Yield	120 pounds	140 pounds

Cook separately and then mix Number 1 and Number 2 and cool slightly before filling. Weighed 10¾ pounds per gallon.

The liquid red color is made by dissolving 2¼ ounces of Amaranth and 1 ounce of Ponceau in 1 gallon of water.

Pineapple:	Number 1	Number 2
No. 10 tins pineapple	9 cans equals 61 pounds net	9 cans equals 64 pounds net
Sugar	35 pounds	65 pounds
Glucose	25 pounds	..
Benzoate	2 ounces	2 ounces
Agar-agar	..	21 ounces
Cook to	195° F.	195° F.
Produced	118 pounds	133 pounds

Mix Number 1 and Number 2 before filling. Produced 23 gallons or 251 pounds, weighing 11 pounds per gallon.

Any fruits can be handled in the same manner. Also the amount of corn syrup used can be increased if desired.

These products must be labeled containing gelatine or agar-agar. Instead of using agar-agar, powdered or liquid pectin is often used at the rate of about 0.2%.

CRUSHED ORANGE:—Remove the outer skin of the orange and remove the seeds and run the pulp through a food grinder.

Orange pulp	38 pounds
Sugar	38 pounds
Benzoate of soda	1¼ ounces

Cooked to 190° F.
Produced 75 pounds
Fill into one-half gallon jars and cap.

They may be processed at 190° F. for 30 minutes if desired.

MARASCHINO CHERRIES:—While this name is applied promiscuously to all hard red cherries that are used in punches, cocktails, salads, confections, etc., most of this type are imitation Maraschino cherries or else cherries packed in Maraschino liquor.

Cherries for this use should be picked when the fruit has taken a little color and sweetness and are picked with the stems on, because a brown discoloration may occur where they have been removed prior to bleaching. They are packed in paraffined fir barrels of approximately 240 pounds per barrel and if more fruit per barrel is used, the fruit crack due to the excess weight. The loss in pitting and stemming for large fruit is 14%, medium fruit 18%, small fruit 20% and dipping fruit 24%. 330 pounds of fresh fruit yields 220 pounds stemmed and pitted. The cherries are graded for size according to the following sizes:

Dipping cherries	10 to 14 millimeters
Small	14 to 18 millimeters
Medium	18 to 22 millimeters
Large	22 to 26 millimeters

BLEACHING:—The old system of removing the color was carried on by soaking the cherries in a strong sulfurous acid solution or by using sulfite of soda in conjunction with sulfuric acid. Dissolve 6¼ pounds of sodium sulfite in 25 gallons of hot water and when cool add 3 pints of sulfuric acid (commercial). Mix well. Sulfurous acid oxidizes to sulfuric acid when in dilute solution.

CAUTION:—Never add the water to the acid as it might splatter and produce a bad burn.

Place the fruit in this acid solution for several days or until the color has been removed. They may then be placed in casks to which 6 pounds of salt have been added for every 50 pounds of cherries and 1½ pounds for every gallon of water used in covering, or the cherries can be bleached by using ½ or 1% sodium metabisulfite in the brine that the fruit is to be stored in rather than using sulfuric acid.

They can also be bleached by subjecting the fruit to the fumes of burning sulfur for about 6 to 8 hours. The cherries are placed on trays in a cabinet or box where they are subjected to the fumes of the burning sulfur. A box of any size can be easily made to hold racks spaced about 6 inches apart with holes at the top or bottom to allow circulation or draught. Underneath the box, place any suitable vessel that can be used to hold the burning sulfur. After bleaching, place in a salt brine as mentioned above.

Should the fruit be used immediately, do not cover with salt, but soak in cold water changing often until there is no longer any perceptible taste. Then stem, pit, and blanch in boiling water 15 minutes before covering with syrup.

These cherries are also treated with alum to make them firm and crisp the same as pickles. If alum is used, either 1 or 2 pounds per 50 gallon barrel of cherries is used in the salt brine. However, alum may cause cracking of skins and softening.

Due to cracking of the cherries, other systems of packing have been developed. Sulfuric acid has been omitted in the present process due to its bad effect upon the fruit. Other chemicals in addition to sulfur dioxide have been used, with resulting superior quality.

Lime and other calcium salts used have resulted in a favorable hardening action and are far superior to alum salts for this purpose. Calcium chloride gave very good results as it had no neutralizing effect upon the sulfurous acid so that a lower quantity of sulfurous acid could be used. When air slacked or unslacked lime is used, then an excess of sulfurous acid must be added. When 0.3% unslacked lime is used it requires 0.6% sulfur dioxide so as to leave an excess of 0.3% of sulfur dioxide. One hundred pounds of unslacked lime is equivalent to 130 pounds of slacked.

The addition of about 5% of salt as well as 20% of sugar has been used to help reduce bursting of the skins. Salt is a little difficult to remove so that sugar is better.

E. H. Wiegand and D. E. Billis of Oregon Agriculture Experimental Station recommended several formulas for cherries.

I. "The recommended bleach solution is made by using 1½% (3 pounds) of sulfur dioxide and 3.09 pounds of hydrated lime to 200 pounds (24 gallons) of water. It requires approximately 24 gallons of this bleach solution per 240 pounds of cherries (1 barrel)."

II.	Sulfur dioxide ....1½%—	12 pounds
	Hydrated lime	8 pounds
	Alum	1½ pounds
	Water to make	100 gallons
III.	Sulfur dioxide	1½%
	Hydrated lime	5 pounds or
	Calcium carbonate (precipated chalk)	7½ pounds
	Magnesium sulfate	2½ pounds
	(may be omitted if desired)	
	Tannic Acid	1 pound
	Water to make	100 gallons

Another bleach solution is made by using calcium carbonate

Sketch below shows actual sizes of five different grades of maraschino cherries and approximate number of cherries per gallon.

(precipitated chalk or whiting) at the rate of 35 pounds mixed in 500 gallons of water and pass into this 65 pounds of sulfur dioxide.

It is necessary that the bleach solution be tested as to strength and adjusted to the proper strength of 1.5% sulfur dioxide. In passing the gas into the solution either a hard rubber perforated pipe or else a lead one is used and under no consideration should iron equipment be used in this or any other steps in the process, because of discoloration resulting. It is customary to place the cylinder of gas on a scale and pass the gas into the solution until the proper weight has been used. By regulating the flow of the gas, the bubbles will be absorbed by the water before it reaches the surface. The colder the solution the better the absorption of the gas.

TESTING BLEACHING SOLUTION STRENGTH:—The equipment necessary is:

1. Starch solution 0.5%.

Mix about ½ teaspoonful cornstarch with several tablespoons of cold water. Heat 7 to 8 ounces of water to boiling and then add the creamed corn starch and just boil and take off the flame.

2. Use Tenth Normal iodine solution or a solution of stronger normality if desired.

1 cc. tenth normal iodine solution is equivalent to 0.0032 grams SO_2.

1 cc. tenth normal iodine solution is equivalent to 0.041 grams sulfurous acid.

3. Pipette 10 cc.—one for vinegar testing can be used.
4. Flask—300 cc. Erlenmeyer.
5. Burette 25 or 50 cc. graduated in tenths. (Burette used for vinegar testing can be used.)

Place 10 cc. of the solution to be tested in the flask, add about 2 to 3 ounces distilled water, about ½ teaspoon of the starch solution. Fill and adjust the burette to zero with the iodine solution and slowly add it to the bleach solution. As the solution nears the end or finishing point, the blue color imparted by the reaction of the starch and iodine will become purple or paler until it will finally disappear. Read the burette reading and calculate the percentage of sulfur dioxide. For example if 10 cc. of the bleach require

47.4 cc. of N/10 Iodine then:

47.4 x .0032 x 10 = 1.517 per cent sulphur dioxide.

Another method of testing is to use a Normal sodium hydroxide solution with phenolphthalein as an indicator. The same equipment as above mentioned can be used. Place 10 cc. of the bleach solution in the flask, add 2 to 3 ounces of distilled water, a few drops of the indicator and titrate to a pink color.

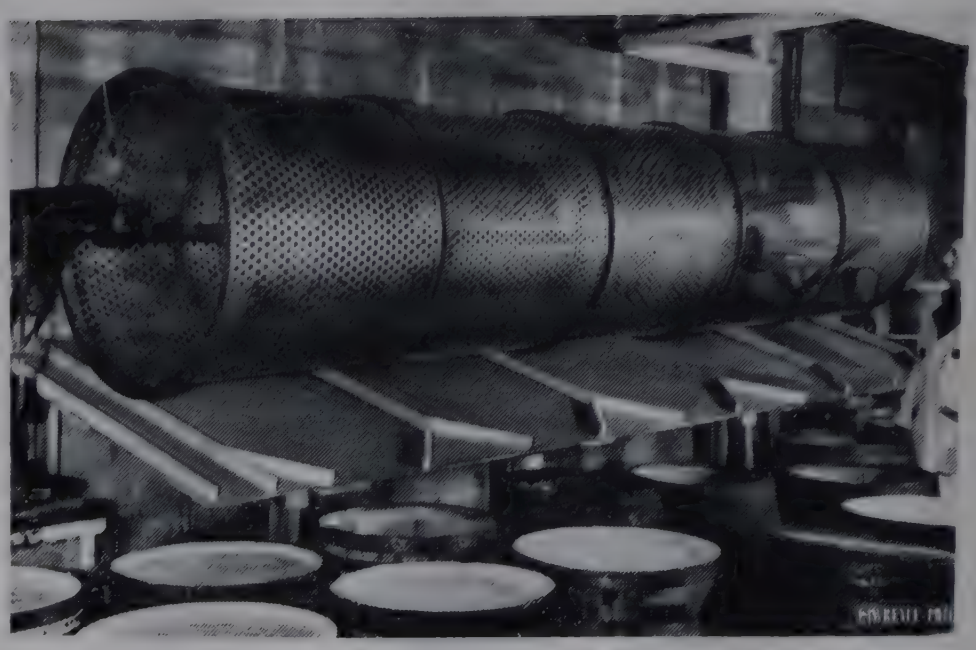
1 cc. N/1NaOH=0.32 grams sulfur dioxide.

Example: if 10 cc. of the bleach required 6.2 cc N/1NaOH then 6.2 x 0.032 x 10 = 1.984%.

The iodine titration method is superior to the NaOH method.

MIXING AND STORING:—Barrels of cherries, filled with the bleach solution should be moved about each day for at least 10 days and re-brined when necessary. As the cherries take up the solution, the barrels must be rebrined to prevent spoilage.

PITTING:—The cherries are ready for stemming, grading and pitting when all of the color has been removed from the cherries. They can be run through the regular cherry stemmer and pitter and sorted for size. However, some factories do all of this work by hand because it produces a superior product, but of course, increases the cost. Before the cherries are stemmed and pitted, they may be washed thoroughly to remove the excess bleach, which of course, is hard on the hands of the workers.



Stainless steel grader automatically sorts and grades raw cherries into various sizes. Sizes range from 10-26 millimeters.

SOAKING TO REMOVE SULFUR DIOXIDE:—The cherries are now ready to have the bleach removed by placing them in hot water at 200° F. and changing this hot water at least twice daily which requires often two or three days to remove the bleach. This bleach must be removed if the fruit is to be dyed properly.

DYEING CHERRIES:—There are two colors used for this purpose namely: Ponceau 3R and Erythrosine or a mixture of both. Erythrosine gives better results as the fruit dyed with this color will not "bleed."

Erythrosine dyes the fruit in an alkaline solution and unless any acid in the fruit is removed or neutralized the color will precipitate out. It is usually necessary to add at least 7 ounces of baking soda (sodium bicarbonate) for each 100 pounds of fruit and 12 gallons of water, heat a few minutes and add 1 to 1½ ounces of Erythrosine and heat to 200-205° F., for about 15 minutes and allow the fruit to remain in the colored water until the desired color is obtained.

The dye is then "set" by heating the cherries in their colored solution and adding 1 pound of citric acid previously dissolved in water and boil for a few minutes and set aside for at least 24 hours for the color to set properly.

If Ponceau 3R is used, add three-eights to one-half ounce of

Continuous pasteurizer below washes filled jars free of syrup, pre-heats, pasteurizes, cools, washes, and dries automatically.

this dye in about 10 to 12 gallons of water, boil to dissolve the dye, then add the cherries and heat to about 200° F. and hold at this temperature for 15 minutes. Allow them to stand until the proper color or shade is obtained.

SYRUPING:—Before starting this process, some wash the fruit thoroughly to remove any color which may have settled out. Cover the fruit with a 25% sugar (Brix) solution and add several ounces of liquid citric acid so that the solution remains acid and boil for about 8 to 10 minutes. Set to one side in this syrup and the next day drain and add enough sugar to increase the content 5% or degree Brix, replace the syrup and continue this method until the fruit syrup tests 65 degree Brix when the flavor can be added to the syrup and the cherries are then ready for bottling. Some heat the syrup each time it is added to the cherries, but care must be taken so as not to shrink the fruit.

The bottled cherries are pasteurized as follows:

2 to 5 ounce bottles	40 min. at 175° F.
8 ounce bottles	50 min. at 178° F.
16 ounce bottles	55 min. at 180° F.

The amount of benzoate added should not exceed 0.1%. The preservative selected should be of a good quality because an inferior quality may impart a peculiar odor and taste to the cherries.

Some corn syrup can be substituted in making a syrup, using one part of 44 degrees corn syrup with two parts of cane sugar. But if used, it must be so labeled.

The following imitation Maraschino flavor can be used at the rate of ½ to 1 ounce per gallon of syrup:

Imitation Maraschino Flavor

Oil of bitter almond	10 ounces or
Benzaldehyde	2½ ounces
Peach extract	2½ ounces
Vanilla extract	1½ c.c.
Oil rose	4 c.c.
Oil orange	4 c.c.
Oil neroli (orange flavor)	4 c.c.
Tincture of orris	1 c.c.
Cognac essence	8 ounces
Alcohol	64 ounces
Water to produce	1 gallon

Artificial color, benzoate of soda and artificial flavor when added must be declared.

In pitting there is a shrinkage and loss in weight of 10%. A barrel of raw fruit of 286 pounds should yield 195 pounds of pitted fruit and this should show an increase during processing of from 5-10%. It usually requires 3 barrels of raw fruits to produce two barrels of finished cherries.

NUT SUNDAE:—The nuts used in making this product should be clean, and free from musty odor or moldy nuts and excessive pieces of shell. Chop the nuts (do not grind) to pieces about as big as beans. Sift to remove fine dust or skin which has a bitter astrigent taste and produces a poor looking product with a cloudy appearance. Fill the jars (½ gallon) with chopped nuts. Cover with a 36° Bé syrup either plain or flavored and 0.1% benzoate of soda.

Two cases of walnuts (55 pounds each) produce approximately 46 one-half gallon jars and requires 13 gallons of a 36° Bé syrup and 4 ounces of benzoate of soda. Should an [illegible] maple flavor be desired, 1¾-2 ounces imitation [illegible] or any good imitation maple extract can be [illegible] the syrup to 190° F. adding the benzoate of soda [illegible] ounces of caramel. Pour over the nuts hot, allow [illegible] several hours for the syrup to be absorbed, then fill to the top, cap, wash, and label. Some sterilize 30 [illegible] The nuts can be soaked over night in a syrup, drained, filled into jars, covered with fresh syrup, capped, and processed 30 minutes at 180° F.

Pecans, blanched almonds, or any other nuts can be used either with a plain or flavored syrup.

Dixie Sundae

Ground cherries (Whole and broken Maraschino type)	1 gallon
Ground English walnuts	2 gallons
Pineapple—crushed fruit	1 gallon
Jamaica ginger extract (double strength)	4 ounces
Cocoa paste (see cocoa paste below)	1 quart
Hot syrup 35-36° Bé	1 gallon (hot)
Benzoate	1/10 of 1 per cent

Mix the syrup, cocoa paste, and pour over the nuts, and add the balance of the ingredients. Mix, fill, cap. It is not necessary to process, but if desirable, do so.

Chop Suey

Whole and broken Maraschino cherries	1 gallon
Pineapple—crushed fruit	1 gallon
Nut sundae—plain	1 gallon
Small raisins—seedless	1 gallon
Chopped citron	1 gallon
Benzoate of soda	1/10 of 1 per cent

Mix thoroughly. If too thick, add hot simple syrup to proper consistency. Fill into jars, cap, and process if desired.

COCOA PASTE AND SYRUPS:—The paste is a very thick product used as a topping for ice cream or it may be reduced with plain syrup to be used as a syrup for sodas. The paste can be made two ways:

No. 1—Heat 10 gallons 35° Bé plain syrup, add 26 pounds of powdered cocoa (any good grade) 2 ounces of benzoate of soda and heat slowly to 190° F. until smooth. Fill into jars hot and cap. Be sure the product is smooth with no lumps.

No. 2—Mix 35 pounds of sugar with 13 pounds of cocoa. Heat 2¾ gallons of water and 1 ounce benzoate of soda, then slowly add the cocoa-sugar to the water, mix and cook slowly to 190° F. until perfectly smooth. Fill into jars. Cap, wash, and label. This should produce 12 one-half gallon jars. This paste can be mixed, one part of paste with 3 or 4 parts of syrup for fountain use. A better flavored product can be obtained by using several ounces of pure vanilla extract and a slight amount of salt—1 pound in 20 gallons.

Cocoa paste molds, so it is advisable to sterilize product.

READY MIXED COCOA is made with these materials:

Cocoa	17 pounds
Powdered whole milk	15 pounds
Fine granulated sugar	48 pounds

Mix all of the ingredients together for at least one-half hour. Only a milk that is soluble and will not settle, should be used. About 1 to 2 teaspoons of the mix is stirred with an electric mixer in a glass of water. Be sure and try the milk for solubility before using it.

COCOA SYRUP:—One type can be made by diluting 1 gallon of the above cocoa paste with 1 gallon 36° Bé simple syrup and adding benzoate of soda to preserve. Cocoa spoils very easily so that a preservative must be used and sterilization is also advisable.

Another method is as follows:

Cocoa	5 pounds
Salt	4 ounces
Vanilla extract	5 ounces
Sugar	40 pounds
Benzoate of soda	[illegible]

Water to make (about 2½ gallons) 5 gallons of finished product. Mix the cocoa, salt, and sugar together and add to the water to which has been added the benzoate, and heat slowly to 190° F. Stir to prevent lumping and cook until perfectly smooth. Add the extract, mix well, and fill into jugs or bottles.

SIMPLE SYRUP:—A plain syrup can be made by dissolving granulated sugar in water with or without benzoate of soda. It can be made either hot or cold, in kettles or percolators. The latter makes a clean, clear syrup that does not crystallize as readily as syrups made by the hot process. A percolator can be of any size but should be sufficiently large to make up about a barrel at a time. They are cylindrical and the top portion (in case of a large one) will hold at least one barrel of sugar and about 25 gallons of water, while the bottom portion will hold 50 gallons of the syrup. The two parts are separated by two screens that keep the sugar from falling into the lower compartment and also strains the syrup as it passes through. The screen may be covered with canton flannel to aid in straining. Dump a barrel of sugar (350 pounds) into the top part and then add 23 gallons of cold water. As the water percolates through, it dissolves the sugar, thus making the syrup. Coarse granulated (confectioner's sugar) is preferable as it will not mat or pack as solid nor form channels as will fine granulated. This will produce 50 gallons of a 36° Bé syrup.

Syrup can be made by heating sugar and water until dissolved and then straining or filtering to clarify.

The strength of sugar can be made to suit the needs of the trade; very often a 32° Bé is preferred; if so use 27 gallons of water instead of 23. Syrup is also made by substituting corn syrup for some of the sugar. The following is a formula:

Water	1 gallon
Corn Syrup (42° Bé)	1 gallon
Sugar	8 pounds

Heat the water and glucose and then add the sugar, heat until dissolved, then strain.

INVERT SYRUP:—As some syrups crystallize, they are often treated with a small amount of fruit acid to start inversion of the sugar into dextrose and levulose. This can be accomplished by heating slowly (not boiling) for one-half hour the following ingredients.:

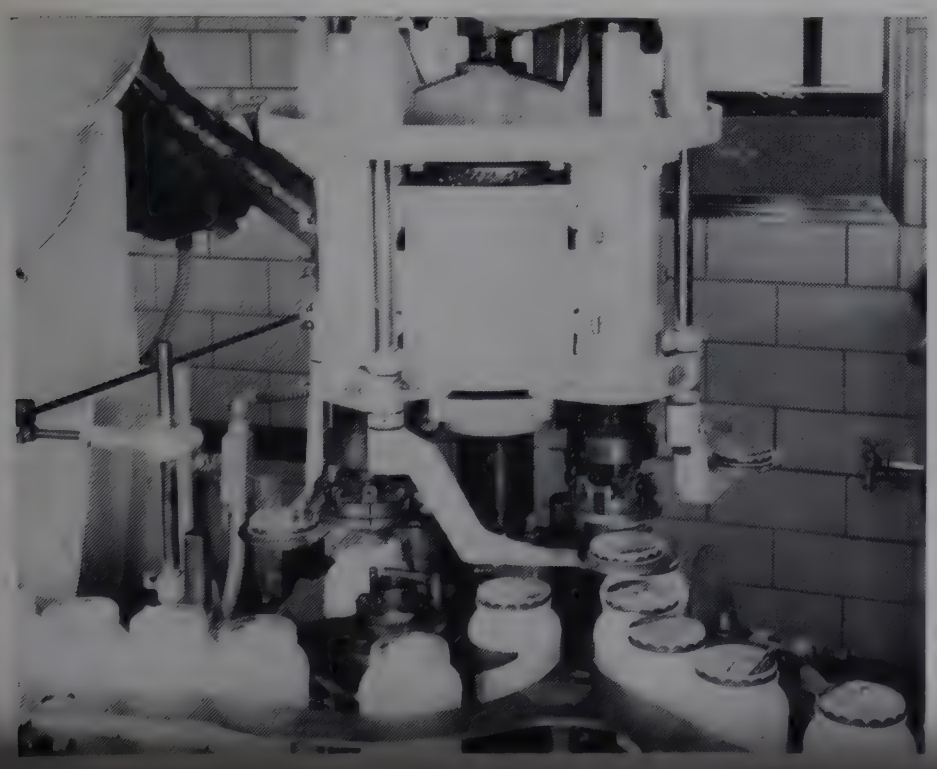
350 to 355 pounds sugar (barrel)
25 gallons water
7 ounces fruit acid

There are several other methods for making invert syrup. One by using tartaric acid to invert the sucrose and another by using invertase as an enzyme.

Should tartaric acid be used, add 8¾ ounces of this acid to 1 barrel of sugar—350 pounds—dissolved in 10 gallons of water and heat to 200° F. and keep at this temperature for one-half hour. Cool and neutralize the excessive acidity by adding 9⅝ ounces of bicarbonate of soda.

MARSHMALLOW TOPPING—FORMULA 1:—Soak over night 1 pound of flake egg-albumen in 32 ounces of water. Cook 15 pounds of sugar, a little water, and 1 pound of guiac gum to 238° F., then add 55 pounds of glucose and mix well. In the meantime beat 10 pounds of glucose and the soaked egg until light and then slowly add the sugar, glucose, gum mixture, and beat until light. Add any flavor buyer desires such as vanilla, maple or lemon to suit the taste. This makes a topping that does not separate.

Four headed screw cap machine automatically caps 120 jars of marshmallow topping per minute. No operator is required, only an attendant to replenish the cap feed.



Formula No. 2

Sugar	20 pounds
Glucose	35 pounds
Potato starch	5 pounds
Egg albumen (Soaked over night)	1 pound

Cook 20 pounds of sugar with water to 240° F., add 25 pounds of the corn syrup and mix. Beat the soaked egg with 10 pounds of glucose then add the sugar, corn syrup mixture, beat well and then dust in the potato starch. Beat until light. Flavor.

Formula No. 3

Corn syrup	24 pounds
Sugar	6 pounds
Cook these two to 238° F. and beat.	
Egg albumen	8 ounces
Water	32 ounces
Soak these two over night.	
Gum arabic	8 ounces
Glycerine	6 ounces
Water	18 ounces
Mix these three together.	

Flavor to suit.

To the cooked sugar and corn syrup add the soaked egg, beat until fairly light and then add the gum and glycerine, beat until light and flavor to suit taste.

Formula No. 4

Albumen	20 ounces
Water	5 pints
Granulated sugar	10 pounds
Salt	4 ounces
Glucose	51¾ pounds
Imitation vanilla—colorless	1 ounce

Handle the same as Formula Number 1

FRUIT ACID:—A solution of fruit acid is made by dissolving 4 pounds of either citric or tartaric or both in 1 gallon of water. Filter. Usually 2 ounces of this solution per gallon of syrup is sufficient.

CHERRY:—Crush or grind 100 pounds of cherries and add 30 pounds of sugar and stir well; then allow the fruit to stand about 12 hours in order to extract the flavor and juice. Place the fruit in a kettle, add 2 gallons of water and cook slowly for 10 to 15 minutes. Strain and press to obtain the

juice. To each gallon of juice add 7 pounds of sugar and concentrate to 20 degrees Bé. Strain or filter, add 1/10 of 1 per cent benzoate of soda. Fill hot. Should a wild cherry flavor be desired, the crushed pits can be added to fruit when cooking.

This general method for making syrups can be applied to all of the fresh fruits. Where canned fruits are used, the drained fruit may be used for crushed fruits and the juice cooked with sugar in making syrup. Use 8 pounds of sugar for each gallon of juice and add 1/10 of 1 per cent of benzoate of soda.

WILD CHERRY FLAVOR:—Use 5 pounds of coarsely powdered wild cherry bark, 1 pint of glycerine, 1 pound of sugar. Mix the sugar and bark thoroughly, then add the glycerine and mix. Add enough water to moisten and allow the mixture to macerate 48 hours. Pack the bark in a percolator and cover with enough water to make 1 gallon of extract. Pass the extract through several times to extract the flavor and clarify. This should also aid in making a clear extract. The amount of glycerine present should be sufficient to preserve the extract; if not, then add 1/10 of 1 per cent benzoate of soda. Usually 2 to 4 ounces of this extract per gallon of syrup with the addition of 2 ounces of liquid fruit acid (4 pounds acid per gallon of water) makes a wild cherry syrup. A better flavor can be obtained by the addition of 1 to 2 ounces of true fruit cherry syrup or extract.

ORANGE SYRUP:—This is usually made by adding two ounces of a tarpeneless orange extract and two ounces of liquid fruit acid per gallon of simple syrup, with or without the addition of benzoate of soda and orange coloring (2 ounces liquid color). As emulsions are being used more because they can be made without alcohol, it is almost impossible to give the amount necessary to make a syrup unless the strength is known. For a single strength emulsion, use ½ ounce; double strength, use 1 ounce; and for quadruple strength use 2 ounces per gallon of syrup. The color and acid may be added when the syrup is diluted rather than when the product is made. Use Orange I by dissolving 4 ounces per 1 gallon distilled water.

LEMON SYRUP:—This is made in the same manner as orange, using either terpeneless lemon extract or emulsion.

VANILLA SYRUP:—This is made by mixing:

*1 ounce of special vanilla extract
1 ounce of carmel
1 gallon of syrup
Mix well. Benzoate if desired.

***Special Vanilla Extract**

Pure vanilla extract.....	1 quart
Vanillin	1 ounce

Dissolve the vanillin in the extract by mixing and warming slightly.

Should a stronger flavor be desired, then add to the above special vanilla extract, ½ ounce of coumarin. Do not use any acid with this syrup.

Such syrups as ginger ale, root beer, sarsaparilla, etc., used by the "pop" bottler are made by adding extract to simple syrup. Usually 1 to 4 ounces of extract per gallon of syrup gives the necessary flavor with the addition of 1 to 2 ounces of fruit acid and color.

CANDIED FRUITS may be prepared by concentrating [illegible] until they are pregnated with a high sugar [illegible] they are dried. Glace is really a candied [illegible] surface on the finished product.

[illegible] of the work in producing these fruits is hand [illegible] and tedious and requires careful handling [illegible]

Only firm fruits can be used to produce a quality product. Soft or over-ripe fruit should not be used.

GENERAL METHOD:—In manufacturing this particular class of goods the fruit should be handled so that the sugar will be absorbed slowly until it is of such a concentration that the fruit will keep indefinitely. If the fruit is handled too roughly or the rate of absorption is too rapid due to hurried process, then it is apt to become soft and break apart or toughen and shrivel. By gradually increasing the percentage of sugar by repeated boiling and soaking the desired results may be obtained.

After this step the fruit may be crystallized or glaced.

As it would be almost impossible to handle all the fresh fruit as it comes into the factory, it may be stored in a dilute solution of sulfurous acid (½%) or sodium metabisulfite (½%) to preserve and harden the cell tissue until needed. This prevents fermentation and spoilage. When ready to be used the acid must be removed by soaking repeatedly in either hot or cold water.

Unless the skin of the fruit is pricked before starting the process, it should be done before the bleaching. This permits the syrup to penetrate and prevents shrinking of the skin and the fruit from breaking apart. Do not use iron or steel needles, as they will leave black spots wherever they penetrate; copper wire should be used.

BLANCHING:—The fruits are blanched to soften the tissue by heating slowly until they float. Remove and chill immediately in cold water. Should the fruit be soft it can be blanched in a dilute alum solution (4 ounces of alum per 16 gallons of water), or else soaked in this solution until firm. The fruit is then well drained and placed on shallow trays or dish pans for the sugar syrup.

CANDYING IN GRANULATED SUGAR:—Make a syrup of 28 to 30° Brix and pour the hot syrup over the fruit. Allow this to stand about 12 hours or even longer for the sugar to equalize, then drain and add sugar to the syrup to increase it at least 5° Brix. Heat and again cover with this syrup. At the end of 24-36 hours again drain the syrup, and add sugar to increase the content 5° Brix more, heat and pour over the fruit. Continue this process until the syrup has reached 65 degrees Brix. The fruit by this time should have absorbed enough sugar to have become saturated.

It can then remain in the syrup as long as desired without danger of spoiling. A light syrup is used at first in order that osmosis will not be too rapid and break or shrivel the product; besides a low syrup penetrates much better.

CANDYING WITH GLUCOSE AND SUGAR:—Corn syrup is often used with granulated sugar in candying the fruits. While granulated sugar preserves the product with a sweeter and better flavor, yet it is apt to become too dry, hard, and crystallize, and the fruit will not have the transparent appearance with the original fruit shape. Use about one-third corn syrup and two-thirds granulated sugar. Should more corn syrup be used the product will be sticky, and damp, and not present as fine an appearance.

To keep the fruit under the surface of the sugar liquid use either wooden or wire racks.

DRAINING AND DRYING:—After the syrup and fruit are saturated, it is ready to be dried. Remove the syrup by draining and either wipe the excess syrup from the fruit with a damp cloth or dip it quickly into boiling water and place on racks or screens to dry. Dry at atmospheric temperature or in a drying room at from 110-120° F. Often stone jars with a draw-off at the bottom are used in order not to disturb or handle the fruit any more than is necessary.

CRYSTALLIZING FRUITS:—Cherries, pineapples, peaches, figs, and plums may be crystallized in the following manner. Thoroughly drain the candied fruit to remove the

syrup and place the fruit in single layers on trays. Make up a syrup of sugar and water, boil it to 220° F. and when cooled to 190° F. cover the fruit with this hot syrup and allow to stand 10 to 12 hours. Drain the fruit well and place it in a drying room until crystals form. Do not disturb the trays while the syrup is on the fruit as this may spoil the crystallization. Trays with an opening at one end should be used so that the fruit is not disturbed while the syrup is being removed. Never touch the fruit with the fingers until ready to pack and crystallization has been completed.

GLACE:—Heat the syrup to 290° F. and add about one teaspoonful of cream of tartar to 240 pounds of syrup (about 25 gallons). Dip the fruit into the hot syrup and pick out separately and place on waxed tin sheets. Should the fruit not take up the syrup, dip a second time. Dip only a few at a time and handle with a long fork or spoon. The trays may then be placed in hot rooms until perfectly dry.

Corn syrup may be used with sugar to make glace fruits and nuts using two parts of corn syrup and one of sugar. While the product will not be as sweet, they are harder and firmer with a more transparent finish. As glace fruits are extremely sweet, corn syrup will offset this and give a more characteristic fruit flavor.

ORANGE, LEMON, AND CITRON PEEL:—These skins usually come packed in pipes or hogsheads preserved in a 60° salt brine. When they are to be used, open and run off the brine and flush with water. Transfer to a kettle and again flush with water that has been heated to about 100° F. Drain and flush five times at hourly intervals.

The soaked skins are well drained upon removal from the soaking tank and carefully packed or capped one inside the other all around the vessel or tub until it is half full. Make a ten-degree Bé (18° Brix) syrup and pour over the skins and use a rack or screen to keep them immersed. After 24 hours, run off this syrup and build it up to 10° Bé to be used on the next batch of skins.

Make a fresh 20° Bé or 37° Brix syrup, and again cover for 24 hours. Drain and add sugar to build the syrup to 24° Bé or 44° Brix and cover for two days more. Drain again and build the syrup up to 28° Bé (52° Brix) and again cover and allow them to remain in the syrup until ready to be used.

All syrup must be added boiling hot. The reason the 10° Bé is added first is to leach out any salt, replacing it with the weak sugar solution. A heavier syrup at the start would rapidly fill the pores near the surface and not permit the proper absorption of the sugar to the interior and spoilage would result.

When ready for use take the peel out of the syrup and place face down on wire trays for 12 hours to drain and place these trays on racks in the drying room from 6 to 12 hours at 110°-120° F.

The skins can be cut into squares or strips and packed in wax cartons or in kegs or casks for bakers, manufacturers of mincemeat and plum pudding.

CRYSTALLIZING PEEL:—Make a syrup of sugar and water and boil to 240° F. Shut off the steam and rub the inside of the kettle with a flat piece of wood to start a grain or crystallization in the syrup. Keep the syrup warm while dipping the candied peel. Should the skins seem to be taking up too much syrup turn on the steam for a short period. Dip small batches at a time so that they can be taken out without cooking. Place them face up on the same trays that were used during the candying process. Drain the excess syrup leaving a small quantity in the cap which will harden. Dry and then pack in wax lined boxes.

If properly drained the cake of sugar in the cap should remain intact but if not properly drained the moisture will loosen the sugar coating and the peel will become dry, hard, and white.

Skins to be properly cured should be almost their natural color and almost transparent. Unless these precautions are taken there will be an excess of shapeless skins which must be sold as drained peel or seconds.

CANDYING CHERRIES:—The cherries must be treated in a similar manner up to the drying stage. To candy, use a sugar syrup cooked to 240°F., but do not drain it; dip the cherries quickly with a wire net and spread out on a wire sieve to harden. Then pack in boxes.

PINEAPPLE:—This is handled the same as cherries.

In one modern vinegar plant, this instrument is connected to key points in several generators and can record the temperature at any point selected by the operator.

Section 3—

Vinegar Making And Pickling

Chapter I

Scientific Principles

VINEGAR MANUFACTURE

THE term vinegar is derived from two French words that mean sour wine, but in the United States the term is applied to the product resulting from an alcoholic and subsequent acetous fermentation of the juice of apples and various other fruits, or an infusion of malted barley and other cereals, or sugar solutions.

In manufacturing vinegar, there are three principal operations or steps in the process:

1. Preparation of the fruit juices or other sugar solution.
2. Fermentation of the liquid to an alcoholic liquor.
3. Generation or acetification of the liquid to a vinegar.

Vinegar making depends upon a series of chemical and physical changes which take place progressively. On account of the vast importance of cider vinegar, this product will be discussed first.

CIDER VINEGAR:—Preparation of the apple juice or cider. This step is a mechanical separation of the juice from the apples by means of grinders and presses. For cider vinegar, usually the run of the orchard, culls and windfalls are used; bad or rotten stock should be eliminated as they will often impart a musty taste to the cider and generators. The apples for vinegar are not usually washed, as there is wild yeast clinging to the surface and washing may retard the alcoholic fermentation, and permit undesirable changes to take place. Apples from orchards that have been sprayed with arsenic solutions to control insects should be washed in a dilute 1% hydrochloric acid solution and then rinsed thoroughly with fresh potable water, to remove the danger of poisoning. This treatment is especially necessary if the [illegible] been very dry with little rain to wash off [illegible]

FERMENTATION:—This process is the conversion of the sugar into alcohol and carbon dioxide acid gas. The sugar [illegible] in fruit juices is easily acted upon by the yeast. While [illegible]

tended by many difficulties, sensitive to many influences, and its complete and economic progress confined to narrow limits of temperature, development of acidity, the effects of antagonistic bacteria, etc.

The alcoholic fermentation is brought about by yeasts, which are ever present in the air, on fruits, vegetables, etc.

While many fermentologists recommend the inoculation of the sweet cider with pure cultures of yeast, commercially this practice is not carried out. The cider is allowed to take its natural course of spontaneous fermentation. There is no question, however, that pure cultures will produce a better fermentation, resulting in a superior flavor and aroma. Pure cultures added to apple juice have two advantages:

1. It insures the inoculation and fermentation by a strong, healthy culture which will suppress undesirable wild yeast and other ferments which are likely to produce an off-flavor and odor.

2. It will aid in rapid handling of the raw materials.

Bread yeast or brewer's yeast will not give the same results as wild yeast, and should not be used. To promote fermentation, it would be better to add some cider from active fermenting tanks. Cider should be tested with a hydrometer each day to determine if the sugar has been completely fermented. When it tests zero, complete fermentation has taken place.

When the sugar of the cider is acted upon by the yeast, the following takes place:

$$C_6H_{12}O_6 + \text{Yeast} = 2C_2H_5OH + 2CO_2$$

$$\text{Sugar} + \text{Yeast} = \text{Alcohol} + \text{Carbon dioxide}$$

This means chemically that 100 parts of sugar should give theoretically 51 parts of alcohol and 49 parts of carbon dioxide; whereas practical tests show a yield from 48.5 to 50 parts of alcohol.

Theoretical yield means the quantity produced if there was no loss of alcohol or sugar during the process; a practical yield is the actual amount produced commercially. It is always the aim to obtain as high a yield as can be obtained.

The practical yields are compiled from the average reuslts obtained over a period of time.

GENERATION OR ACETIFICATION:—This step in the process is caused by acetic acid bacteria. Acetic bacteria are found in the air and, finding an alcoholic media, such as fermented cider, which is quite suitable for their development and growth, they develop rapidly. Rapid development produces a slimy skin or membrane commonly known as "Mother of Vinegar" (Mycoderm Aceti). This membrane will continue to form and settle as long as any alcohol remains to be acted upon. This was formerly the method of making vinegar in the home, but in the factory an entirely different process is used.

Acetification is really an oxidation whereby the alcohol present is changed into acetic acid. The following shows the changes that take place:

C_2H_5OH + acetic bacteria + oxygen = $C_2H_4O_2 + H_2O$.

Alcohol + acetic bacteria + oxygen = Acetic acid + water.

There are really two steps in the above equation. The alcohol is changed by oxidation into a product called aldehyde (acetic aldehyde) and the aldehyde is acted upon by the acetic bacteria to form acetic acid and water.

Chemically 100 parts of alcohol should yield theoretically 130.43 parts of acetic acid. Unfortunately this is not the case, as the practical yields are from 80 to 100 parts. Should the acetic fermentation utilize all the alcohol present, then the liquid may lose strength, as the acetic bacteria after changing the alcohol to acid consumes some of it for food and thus reduces the strength of the vinegar. It is customary to leave about 0.25 to 0.5 per cent of alcohol in the finished vinegar as food for the bacteria.

Vinegar is manufactured commercially by running the alcoholic liquor through upright cylindrical tanks whose height is several times greater than the diameter. The tank or generator is packed with whatever material one finds will give the best results. They are equipped with false bottom and head, vent holes, dump trough or sparge for distributing the liquid, etc.

The cider stock as it passes over the packing material, divides into small portions, so that the acetic bacteria, impregnating the material, acts upon the alcohol and rapidly converts it into acetic acid. The vent holes supply the oxygen necessary for the growth, development and conversion.

GENERATORS:—These may vary from 3′6″-6′ in diameter 8′-16′ in height. These may be of any size, as there is no fixed standard. The latter size seems to be the one most used for cider generators. However, there seems to be a limit to size, as very large generators (18 or 20 feet in diameter) will not permit the free circulation of air and consequently oxidation is very poor. Generators 6′-16′ have many advantages such as great capacity, ease in handling, space occupied, immunity from rapid external changes, and minimum attention while operating.

The building should have the proper bracings to carry the loaded supply tanks and generators. The equipment should be elevated so that they can be kept clean underneath. After setting up and tightening the generators, run about 6 inches of water in the bottom and turn on the steam hose, throw a cover over the top, and steam all day or night until tight.

When generators are installed on cement foundations or floors or concrete buildings, it is advisable to give the cement at least two coats of pure linseed oil or any good acid resisting paint to prevent the crumbling or disintegration of the concrete which might later result in the collapse of the building. In fact it would be well to coat the outside of the generators or any wooden beams with linseed oil. This will prevent decay of the wood and keep down evaporation loss.

PACKING MATERIAL FOR GENERATORS:—The chief requisite for material to be used in packing generators is that it be fairly porous, present a large working surface for the action of the air, will not mat or pack solid when wet and warm, will not impart flavor nor be affected by the vinegar. The packing materials commonly used are beechwood shavings, corn cobs, coke, pumice stone, and rattan.

BEECHWOOD SHAVINGS:—These are a very desirable material for packing because they impart little flavor to the vinegar, retain their original shape, are strong enough to withstand weight without matting, breaking up, or settling, and can be used a long time without being changed. Tightly curled shavings should be used. In packing a generator, select uniformly curled shavings and stand them on end covering the entire bottom, two rows deep, and then dump in the other shavings. This arrangement in the bottom of the tank permits a free flow of vinegar from the generator and also prevents flooding.

A 6′-6′ generator will require about 350 bushels of beechwood shavings, or about 2000 pounds of long rattan, or 4,584 pounds of pumice.

CORN COBS:—These may also be used, but they soften easily and mat, so that they can be used only one season. These do not require packing, but are simply dumped into the generator. Filling and refilling generators is expensive and wasteful. Vinegar produced in generators where corn cobs have been used, will at first produce a vinegar with higher total solids, non-sugar solids, ash, alkalinity of the ash, and phosphoric acid until these soluble ingredients of the cobs are removed, which may require several weeks.

COKE AND PUMICE STONE:—These are frequently used as packing material, but should be analyzed for iron and sulfur compounds, as they both cause black vinegar with an off taste. Coke is not as satisfactory as pumice for filling generators on account of the iron content, which acts on the tannin in the alcoholic liquor and turns black. This iron may still be present in sufficient amounts to cause trouble even though the coke has been washed with acid before being used, or even after being in a generator under active operation for a year.

High sulfur content of both the coke and pumice (as sulfates soluble in the generated vinegar may place the vinegar under suspicion as vinegar being made from sulfured apples or cores and skins. Pumice is a better material on account of its porousness, freedom from iron and other impurities that impart a taste to the vinegar, and its large oxidizing surface. They too can be dumped into the generator without any special care in packing. However, the cost may be prohibitive.

RATTAN:—Rattan in short lengths can be used for packing material, but is not as successful as rattan bolts. It mats or packs tightly, prevents the free circulation of air and vinegar, and will be more likely to cause internal disorders. Rattan bolts give excellent results, require considerable time in making, but have advantages that more than offset the disadvantages. Greater capacity can be obtained, and in case of disorder, they can quickly be removed, washed, steamed, and repacked within a very short time.

Rye straw, while not being used as packing material for generators, can be used as a filtering or straining material placed on top of the shavings.

OPERATION OF GENERATORS:—On account of the idiosyncrasies of each generator, it is impossible to lay down any general rules that can be applied to the operation of all generators. While they may have been assembled, packed and handled the same, yet each one has its own individuality which makes it stand out in opposition to the others. All operators realize this about each generator and handle accordingly; they know the good workers, as well as the

poor ones.

There are many factors that control the capacity of generators. One of them is the atmospheric temperature. Generators operate far better in extremely cold weather, so that during the late fall, winter, and spring, they should be operated to full capacity because the internal temperature can be controlled. Should a generator fail to produce the proper acidity or capacity, it may be due to several reasons; namely, clogged feed pipes, leaky dumper, head not level, uneven distribution of the wash, leaky generator, pockets where the packing material has matted, plugged holes in the false head and slime accumulated on top of the packing material, or a poor stock.

The longer one operates generators, the easier it will be to locate the trouble and remedy the same, whether it be a structural, chemcial, or physical weakness that has developed. There are certain general rules about the operation that can be laid down, but the operator will have to use his own judgment when irregularities and abnormal conditions arise.

The holes in the head (when heads are used) should be cleaned every few days to allow free circulation of the air and they should be removed and steamed to remove slime every 10 days or two weeks, depending upon how fast they are working, the clearness of the stock, and how soon they slime. Should there be a loss in acid and alcohol, then the flow should be increased, or if there is a gain in alcohol and acid, then the flow should be decreased. In no case should the rate of flow be increased or decreased over 10% in 24 hours, except for some special irregularity.

The person operating generators should know the relationship of sugar to alcohol, and to acetic acid, and should be familiar with the methods used in testing for acid and alcohol, and the interpretation of the same. Usually 2% sugar produces 1% alcohol, and the 1% alcohol produces 0.8-0.9% (8 to 9 "grains") acetic acid. For example: Suppose the sweet cider had an acidity of 0.69% as malic acid, with 14.4% sugar, then the cider should produce 7.2% alcohol which should produce 5.76% acidity (7.2 x 0.8) or the total acidity should be 5.76 + 0.69 = 6.45% or 64.5 "grains."

Interior of a modern vinegar plant. Alcoholic medium is poured through top of each tank over packing such as beech shavings. From a sanitation standpoint tanks are elevated.

In order to efficiently operate generators, it is necessary that the operator make accurate tests on the wash going in the generators and the vinegar produced. These tests tell whether the proper acetification is taking place, or whether the alcohol in the wash is passing through unconverted, or is being consumed or wasted.

VINEGAR FLIES:—(Drosophia spp.)—The presence of this insect in large numbers is a sign of unsanitary conditions about the plant. As the fly lives in an atmosphere ladened with acetic acid and breeds in the acid fruit juices, its presence can be minimized by sanitary precautions. Keep the factory clean and do not allow stock or mix to be spilled without cleaning it up.

The larvae of the fly are deposited wherever it is wet or damp, and often increase in such numbers as to work into the generator. They are usually a forerunner of disarrangement in the generator. They are often found abundantly near the draught holes, and have been known to even choke the air supply, and have become so bad as to be almost an epidemic. When present in such quantities, it becomes a serious matter, calling for drastic means to eradicate them.

By closing all the doors and windows and burning a sulfur candle, they can be exterminated; however, sulfur fumes (sulfur dioxide) are quite soluble in the liquid so that the wash should be discontinued temporarily and the tanks covered. If care is not taken, the fumes may get into the generators and kill the acetic acid bacteria. When precautions are taken, the amount of sulfur dioxide absorbed will be small, especially when diluted with vinegar. A wide mouth bottle of about 6-ounce capacity filled about ¾ full of cider or mix and placed on each generator attracts the flies and they may then be destroyed.

VINEGAR EELS, OR WORMS:—(Anguillula acetic Muel)—The origin of this small organism in vinegar is not known, but it may be due to infection from such sources as bad apples, or even from vinegar flies. Air or oxygen is necessary for their growth and development and as oxygen is also one of the chief requisites for the acetic bacteria, the eels may abstract the oxygen and cause disorder.

Closing the air vents for about 36 to 48 hours may destroy them, but it may also stop the air circulation so that the generator may have to be started anew. Flushing the generator for a few hours may remove the eels, but the runoff will have to be heated to 130 or 140° F. to destroy them or the mix going in heated to the same temperature. A 1% of salt in the mix may destroy the eels or the generator can be drained, all the air vents closed, and then flushed with hot water. It seems advisable not to add any foreign substance to the vinegar or generator.

TO DESTROY EELS:—A thin layer of paraffine, mineral, or edible vegetable oil may be poured over the surface to exclude the air supply or the vinegar may be placed in tightly bunged barrels. At some later time they can be removed by filtering. They are readily destroyed by heating to 130° F. If desired the vinegar can be heated to 150 or 160° F. to sterilize and then filter. Filtration alone will also remove the eels. While they are harmless when ingested, yet from aesthetic point one may object seriously to their presence.

VINEGAR MITES OR LICE:—(Tyroglyphus longiorll and Tyroglyphus siro Gero)—The presence of this small organism often occurs even when conditions are sanitary about the generators. Usually they are found in and around the air vents on the top of the staves, at the joints or seams or any place where the wood is moist. Under favorable conditions of warmth and moisture, they breed very rapidly and may contaminate the generators, barrels or containers and spoil the contents. They are even more undesirable than eels or flies because they may be carried by humans.

Steaming the outside of the generator or wherever they are found will destroy them. The vent holes should be thoroughly cleansed by swabbing with boiling hot water. Once they are present it requires watchfulness for some time, so that a repetition will not occur. Such substances as kerosene or turpentine or other disinfectants should not be used because of the danger of their getting into the vinegar.

INSTALLING AND FILLING GENERATORS:—They should be leveled when erected and all bottoms, compartments, and heads should also be perfectly level. The false bottom, if one is necessary, is placed 10-12″ above the true bottom. It is not necessary to divide a 4-10′ generator into compartments but a 6-16′ may be divided into two or three sections by means of partitions, although it is not necessary if the packing material, such as shavings, is put in lightly. The shavings are filled to almost the false head, as they sink greatly when wet. The false head, 12 inches from the top of the generator, is bored with ⅜-inch holes spaced 4 inches from centers. Head should have adequate support to keep it from warping and getting out of plumb. The holes, which are conical and taper towards the bottom, should be burnt smoothly to prevent accumulation of the slime.

Many do not use false heads and dump troughs in the generators but have a special spray or "sparge" system to distribute the vinegar mix. The mix is fed to a small automatic tank, which empties or discharges when it becomes filled thus starting arms to revolve and discharge the mix uniformly and regularly. This system working properly is vastly superior to the old pump trough and false head which required almost constant attention. The parts are of hard rubber and therefore free of metallic corrosion. There are hard rubber dump troughs obtainable now which are far superior to the old wooden ones that often leaked and warped and caused the generators to become erratic.

The air vents are equally distributed and are bored obliquely about 8 to 9 inches from the bottom. Burn them smooth to prevent breeding places for flies, lice, and eels.

CLOSING DOWN GENERATORS:—When all of the cider stock has been exhausted before the next season's run is ready, it is necessary to shut down the generators for a short time. This can be done without disarranging the packing material. After all of the stock has been run on the generators, close all the air vents, and drain thoroughly. Remove the heads, wash, steam, and remove the layer of straw.

About every 10 days or two weeks, run about 150 gallons of vinegar over each generator to keep them sweet and all parts moistened so they will not dry out. Watch carefully around the vent plugs, top and bottom of the staves, dump troughs, etc., for lice. Some recommend that cold water be run through the generators until the acidity has been reduced to 10 grains, and this low acid run over them every ten days or two weeks. This method is likely to cause musty and slimy generators and permit the growth of vinegar pests to such an extent that it may be necessary to remove and wash the packing material before they can again be successfully operated.

REDUCING VINEGAR:—In handling vinegar it is often necessary to dilute or reduce with water to a given acidity, or mix several vinegars together to obtain a certain acidity. There are several methods of obtaining the result. Examples:

EXAMPLE 1:—How many gallons of 68.0 "grain" vinegar and water are necessary to make 300 gallons of 42.0 "grain" vinegar?

SOLUTION:—300 gallons of 42 "grain" vinegar contain (300 x 42) or 12,600 "grains." 68 "grains" = strength of vinegar used. Then 12,600 ÷ 68 = 185.3 gallons of 68 "grain" vinegar and (300 − 185.3) 114.7 gallons of water must be added.

ANOTHER METHOD:—

68.0 (vinegar) — 42 parts or gallons of vinegar

42

0.0 (water) — 26 parts or gallons of water

68 parts = total mix

$$\frac{42}{68} \times \frac{300}{1} = 185.3 \text{ gallons of vinegar}$$

$300 - 185.3 = 114.7$ gallons of water

EXAMPLE 2:—Blend two vinegars of 55.6 "grains" and 33.8 to produce 45.1 "grains."

55.6 — 11.3 parts or gallons of 55.6 "grain" vinegar mixed with

45.1

33.8 — 10.5 parts or gallons of 33.8 "grains" will produce 45.1 "grain" vinegar

PROOF:—

$11.3 \times 55.6 = 628.28$
$10.5 \times 33.8 = 354.90$

21.8 — 983.18

$983.18 \div 21.80 = 45.1$

EXAMPLE 3:—How many gallons of 52.3 "grain" vinegar must be added to 1150 gallons of 30.8 "grain" vinegar to produce a 42.1 "grain" vinegar?

52.3 — 11.3 parts of 52.3 "grain" vinegar

42.1

30.8 — 10.2 parts of 30.8 "grain" vinegar

Since 1150 gallons is the amount on hand, then by simple proportion:

10.2 : 11.3 : : 1150 : x

x = 1274 gallons of 52.3 "grain" vinegar blended with 1150 gallons of 30.8 "grain" to produce a 42.1 "grain" vinegar.

EXAMPLE 4:—Required to produce 4450 gallons of 47.1 "grain" vinegar by blending two vinegars testing 58.3 and 40.1 "grain":

58.3 — 7.0 parts of 58.3 vinegar

47.1

40.1 — 11.2 parts of 40.1 vinegar

18.2 parts in mix

$$\frac{7}{18.2} \times \frac{4550}{1} = 1750 \text{ gallons 58.3 "grain" vinegar}$$

and

$$\frac{11.2}{18.2} \times \frac{4550}{1} = 2800 \text{ gallons 40.1 "grain" vinegar}$$

PROOF:—

$7.0 \times 58.3 = 40.81$
$11.2 \times 40.1 = 44.91$

18.2 — 85.72 total

$$\frac{85.72}{18.2} = 47.1$$

GENERAL RULE IN DILUTING:—A simple rule for producing a definite number of gallons of vinegar of a definite strength, using vinegar of a higher acidity and water; multiply the number of gallons desired by the acid desired and the product equals the number of grain gallons; divide this product by the acidity of the vinegar used, and the quotient will equal the number of gallons to be used.

EXAMPLE:—Required to make 2948 gallons of a 42.0 "grain" vinegar by using 58.6 "grain" vinegar with water.

$$2948 \times 42 = 123{,}816 \text{ grain gallons}$$

$$\frac{123{,}816}{58.6} = 2106 \text{ gallons 58.6 "grain" vinegar}$$

$$2948 - 2106 = 842 \text{ gallons of water}$$

REVOLVING GENERATORS:—This type is used somewhat in the production of cider vinegar but on account of low production, time required, and cost of operation, they are not used by the small vinegar manufacturer. They have certain advantages that the upright generator does not have; namely: lack of attention necessary in operation, greater yield of acid (one part of alcohol will yield 1% of acid), and non-sliming feature. Vinegar made by this process is usually very low in total solids but high in acidity.

The revolving generator consists of a rectangular covered tank containing the fermented stock, in which a slatted drum containing beechwood shavings revolves very slowly once in 24 hours. It takes about four to six weeks to complete the process.

CLEANING TANKS AND GENERATORS:—When the cider stock has been emptied from a tank, it is of vital importance that the tank be thoroughly renovated before any person enters. This may be done by spraying the interior with water, which absorbs the carbonic acid gas (carbon dioxide); placing an electric fan in the tank to blow out the foul air; by placing a large hose in the tank near the bottom and pumping, or by blowers. The tank can have 2-inch holes bored in every stave about 1 foot above the bottom and when emptied the plugs can be removed and as carbon dioxide is heavier than air it will pass out of the tank, especially if fresh air is being supplied from the top. Test the air to see whether it will support combustion by lowering an oil lamp or candle into the tank. No person should be permitted to enter until the air is all right. Even then a belt with a rope attached should be fastened to anyone entering and if possible a special gas mask should be used. An ordinary canister gas mask will not do for this type of work because practically all of the space in the tank is occupied by carbon dioxide with no oxygen present. Either a special hose to the outside air should be attached to the mask or a tank of oxygen can be used. Carefully watch the person cleaning the tank, and should they show the least sign of distress, remove them at once.

Tanks that have had vinegar stored in them and are to be used for cider should be given a coating of lime or whitewash in the same manner that pickle tanks are handled. This will neutralize the acid in the wood and remove the active acetic bacteria which are likely to form acid and check the alcohol fermentation before it has been completed.

Acetic acid in about 0.5% will check the activity of the yeast, and 1% will stop fermentation entirely.

In installing vinegar plants the pipe lines should be either glass-lined or wood or hard rubber to minimize the metallic [illegible]. As this is not always possible, brass lines [illegible] pumps are used which of course will introduce [illegible] copper, especially if the lines are not flushed properly before and after using.

[illegible] more severely when the metal is exposed [illegible] partly submerged than when entirely [illegible] immersed in the solution and not exposed to the air. However, when exposed partly submerged, the corrosion is quite rapid and severe and will impart a taste and often color the vinegar. One method of testing the effect of the vinegar upon metal is to partly submerge a piece being tested. Later test the vinegar for the particular metals used or weigh the piece of metal and again weigh to determine the loss due to corrosion. Block tin seems to stand up well but is very expensive. Any bronze containing lead is more rapidly attacked than those not containing it. Using bronze containing lead is a hazard on account of lead poisoning.

Any form of iron should not be used unless of acid resisting composition. A great loss may occur due to black vinegar because an unwise and ignorant purchasing agent may buy black iron pipe to be used for pumping vinegar.

CLARIFICATION:—Vinegar for bottling should be brilliant and clear. As it comes from the generator, it usually has a slight haze. Due to the presence of active acetic bacteria, "mother of vinegar" forms and becomes unsightly in the package. To prevent the growth of the mycoderm, it is necessary to pasteurize the vinegar by heating to a temperature of at least 155° F. and then filtering through quartz, sand, asbestos, or filter aid. Heating also ages the vinegar, especially if heated in wooden tanks. Storing for a period of at least six months will also age the product so that it will lose the harsh odor and flavor and become mellow with a pleasing aroma or bouquet. This ageing process is due to the formation of esters from the alcohol and aldehydes present.

Vinegar can be clarified by settling, precipitating and filtering. The settling process usually takes six months or a year to clarify and even then there may still be a slight haze or cloudiness. Precipitation may be accomplished by the addition of gelatine, isinglass, casein, Julliene powder, bentonite and casein and potassium ferrocyanide. In treating a vinegar with gelatine, dissolve 10 ounces of high grade gelatine in about 4 to 5 gallons of water by heating and then add it to 1000 gallons of vinegar, mix well and allow it to stand until the gelatine settles. The presence of tannin in the vinegar aids in precipitating the gelatine and unless tannin is present in sufficient amounts, it is often necessary to add more in order to settle properly. A qualitative test for tannin may be made by adding a few drops of a dilute solution of ferric chloride to a small portion of the vinegar and note the intensity of the greenish color. The amount of tannin necessary is from 2 to 3 ounces per 1000 gallons of vinegar which should be added several hours before the addition of the gelatine. In using the clarifying agents, it would be well to try a few experiments varying the amount of the agents as well as the amounts of tannin to be added. These tests can be made on individual gallon glass bottles so the results obtained can easily be observed.

FILTERS AND FILTERING:—After treating with any of the above outlined methods, the vinegars are filtered after sufficient time has elapsed to permit the proper precipitation of any suspended particles.

An efficient homemade filter can be made easily by forming a rectangular box or round tank out of 1½ to 2-inch pine or cypress, equipping it with a slatted false bottom. Cover in interior with a cloth that will not permit the filter aid to work through, fill with about 12 to 18 inches of soaked filter aid, fold the cloth carefully so that filter aid cannot escape along the lines of the folds, place a slatted false head or rack on top and then by means of wood screws, tighten to remove the water; drain well. The vinegar can be pumped up through the filter aid or allowed to run down through it. The first vinegar coming through should be run back into the supply tank as it will contain some water and perhaps

some loose pulp. When through filtering, water can be forced through to wash the pulp.

A sand or quartz filter can also be used. A perforated false bottom placed in a tank or barrel is covered with a cloth to prevent the sand going through and then washed quartz or sand is filled into the barrel. Drain well to remove the water. One of the chief objections to using sand is that it invariably contains iron and organic matter. The iron being soluble will cause a darkening in the presence of tannin, thus making the product unsaleable. Iron in appreciable amounts will often impart an astringent taste that can be removed by precipitating with gelatine and tannin. It is better to safeguard and see that no iron salts get into the product rather then be compelled to treat the vinegar later.

BLACK VINEGAR, ITS CAUSE AND CURE:—The manufacturers of vinegars have their difficulties just the same as the manufacturers of other food products. Some of these difficulties are easily mastered, whereas others seem almost hopeless; but if studied properly and attacked from the right angle, they can be solved. One of the great problems which may confront the manufacturer of vinegars is "black vinegar." This is caused not by one thing of itself, but by a combination of several things.

Often due to accident, such vinegars as cider, malt, sugar, or fruit vinegars may become so black as to become unsightly as well as unpalatable by the deposit of a heavy precipitate. This condition quite often is due to an accumulation of iron salts, either acquired during the process of manufacturing the liquid or else by contamination due to contact with iron pipes, tanks, connections, or by the accidental dropping of iron nails or tacks into the tanks or shipping barrels. Iron is normally present in amounts up to 3 milligrams per 100 c.c. or 30 parts per million but when it becomes present in 10 milligrams or more (100 parts per million) then the vinegar will usually become black. Due to some of the iron being present in a ferrous condition complete precipitation may not be accomplished until later when the iron is converted to the ferric condition. This soluble iron, uniting with the tannins which are normally present in the liquid or extracted from the generating materials, tanks or cooperage, may cause the vinegar to become inky black, blue black, or greenish black cast or fluorescence.

The iron itself will not cause "black vinegar"; neither will the tannin alone cause it. Again, both the iron and tannin might be present but not in sufficient amounts to produce the "black vinegar"; but when present in the proper ratio, then "black vinegar" results. Or the proper combination might exist, but require some time to effect the change, due undoubtedly to the form in which the iron is present. Often the change will not take place until several months after the stock has been generated and ready to be shipped to the market.

When black, the vinegar is usually unsaleable. In addition to the color, the vinegar has a metallic, astringent taste which is also very objectionable.

In order not to lose the vinegar, it must be made palatable as well as marketable by the removal of the iron by the addition of ingredients that do not impart a taste or add anything that is deleterious to health. This can be easily done by treating the vinegar several ways and with different ingredients or precipitants. The iron in the vinegar can be precipitated by added tannin, gelatine, isinglass and potassium ferrocyanide.

PICKLE MANUFACTURE

By pickling, one means the handling of raw vegetables from the time they are harvested, specially handled or treated, until they are placed on the table for consumption. Before they are finished, there are three progressive steps or stages used in handling the raw materials, namely: Salting, Processing and Finishing.

SALTING:—So that raw vegetables may be kept indefinitely if desired, they are placed in salt brine or salt water of different strengths. Thus by salting we mean placing the raw products either in a weak or strong salt solution until they have undergone certain chemical and physical changes which preserve them so they can be used later. This state of preservation may be for only a few days, or for months or years, depending upon "the law of supply and demand" or upon how well the products will keep. This system of salting will permit the shipping of raw materials from the source of supply to a more advantageous selling or finishing point.

It is important that the raw materials use in Salting vegetables be pure and of the best quality obtainable. There was a time when there was little thought given to the raw materials, but due to losses and complaints and great competition, more attention and thought is given to the purchase of better materials.

WATER:—The water used in salting should be as pure as possible. Water high in organic matter, alkaline or hard water, as well as water containing hydrogen sulfide and iron salts in appreciable amounts, should not be used. Water higher in organic matter is likely to have a putrid and decomposed odor after standing. Alkaline water will affect the skin of the pickle and may cause softening of the tissue, thus enabling bacterial decomposition; it may prevent the rapid formation of acidity during fermentation and permit organisms other than those desired to grow and develop, thereby causing decomposition and preventing normal curing.

Alkaline water may even require the addition of vinegar to overcome the alkalinity when one is compelled to use a hard water (lime or carbonate). Hard water usually contains lime and magnesium salts; the former may check the normal natural lactic fermentation and prevent the proper curing, while the latter salt may cause a bitterness. Iron should not be present in potable water to exceed 0.3 parts per million of water because iron salts may cause black pickles, especially when tannin is present. Water containing gypsum and iron may be reduced by bacterial or chemical action, liberating hydrogen sulfide which acts on the iron and produces black pickles. Hydrogen sulfide with its offensive odor may also cause "black" pickles and give a decidedly off-flavor if iron salts should be present. A small amount of vinegar is often added to the water of pickles to prevent the growth of objectionable organisms until the lactic fermentation has started strongly, thus preventing spoilage. Before starting a salting station at any location, at least a gallon of water to be used in salting should be analyzed.

SALT:—Salt used in pickling is a chemical compound called Sodium Chloride. The purer the salt used, the better the results obtained; as an impure salt prevents the proper curing of vegetables.

Salt high in calcium impurities should not be used because the lactic acid formed during fermentation seems to aid in the formation of insoluble calcium salts (such as calcium sulfate—gypsum) which often appears as a white sediment or precipitate or even as white "specks" or spots on the pickles, peppers or tomatoes. Also the calcium (lime) salts may neutralize the acidity formed to such an extent that the spoilage may easily develop. Calcium chloride greatly retards the curing of pickles. Sodium nitrate in salt affects the pickles and makes them unfit for consumption.

Coarse airy salt is used principally because it dissolves more slowly. While a fine salt of about the same finess as table salt is superior for making brine because it dissolves more quickly, yet it is not so good to cover pickles because

it is likely to work to the bottom undissolved, thus making the brine stronger and retarding the fermentation.

In salting vegetables, it is essential that the raw materials be handled as scientifically as possible and in order to do this, it is necessary to make certain tests while salting and during the process of fermentation.

One instrument used is the Salometer or Salinometer, a hydrometer made especially for testing and determining salt in the brine. The scale of the hydrometer is graduated from zero to 100°, zero being the reading of pure water, and 100° being that of a saturated salt solution (26.5%) both taken at 60° F. Salometers as purchased are standardized at 60° in a saturated salt solution, but for ease in calculating and handling records, a hydrometer standardized using a 25% salt solution equal to 100° on the scale is much better. On this scale four degrees therefore equals one per cent salt. One can easily calculate accurately the actual per cent of salt by dividing by four.

Salt percentages, Corresponding Salometer Readings and Amount of Salt required to make 15 gallons of brine

Salt in Solution Per cent	Salometer Reading Degree	Salt necessary for 15 gallons finished brine	
		Pounds	Ounces
1.06	4	1	4.0
2.12	8	2	10.5
3.18	12	4	1.0
4.24	16	5	5.0
5.3	20	6	14.0
6.36	24	8	2.0
7.42	28	9	1.0
8.48	32	11	4.0
9.54	36	12	8.0
10.6	40	14	1.0
15.9	60	21	14.0
21.2	80	30	...
26.5	100	40	...

Freezing point of salt brine of different salt concentrations

Per cent Salt	Salometer Reading	Freezing Temp. F.
5	20	25.2°
10	40	18.7°
15	60	12.2°
20	80	6.1°
25	100	0.5°

ACIDITY:—The acidity of the fermenting salt brine should be tested regularly as it is an important factor in controlling the fermentation of vegetables. The principal acid formed in the fermentation is lactic, all calculations and results are expressed as such.

CUCUMBERS:—Of all the vegetables processed or cured in salt brine, the cucumber is the most important. It is one of the oldest of the garden vegetables, originating in the far east, probably in India about 3,000 years ago, and is believed to belong to the gourd, melon, and pumpkin family.

Analysis of Cucumbers

Moisture	95.40%	95.90%	95.99%
Protein	0.80%	0.80%	0.81%
Fat	0.20%	0.10%	0.22%
Total carbohydrates.. (with fiber)	3.10%	2.10%	1.83%
[illegible]	0.70%	0.50%	0.69%
[illegible]	0.50%	0.40%	0.46%

The sugar is present as invert and easily fermented by the lactic bacteria. The protein and ash (minerals) also act as a food to sustain and develop the bacteria. Composition of [illegible] and vegetables, varies because of climatic conditions, such as rain or drought, heat or cold, and also because of conditions of the soil such as rich or poor, fertilized or unfertilized. The selection of seed is one of vital importance; certain varieties may produce a good yield in one section of the country and a poor one in another and vice versa. Select the seed, which gives the best results for a particular locality and purpose.

After harvesting cucumbers should be delivered to the salting station and placed in brine as soon as possible. Those brought in from the fields in slatted crates are received in much better condition than those brought in bags, as the bags are likely to cause heating, sweating, molding, or a slimy condition which may contaminate a whole tank; whereas a slatted crate allows the circulation of air and prevents the bruising and breaking of the cucumbers. Adequate weighing and unloading facilities should be provided for rapid handling. Sorting machines should be used wherever possible. There are several good types on the market that are effective.

The cucumbers should be sorted into at least four sizes before salting. The first size is up to two inches, the second from two to three, the third from three to four, and the fourth, all the remaining sizes. If early in the season, dills alone can be sorted and all the rest go into vat run and sorted when the tank is emptied.

TANKS:—After sorting, the cucumbers are placed in tanks for salting. These tanks may be of pine, cypress or concrete. If of concrete they should be coated with any good material that waterproofs, will not chip off, or impart any taste either to the pickles or brine. Concrete tanks without some protective coating should not be used, as the concrete, being alkaline in character, will neutralize the acid produced, thereby causing discoloration and softening of the pickles, and permitting the putrefying bacteria to develop.

The concrete tanks are often washed with a solution of tartaric acid and given a vigorous scrubbing at the same time. Then they are dried and rinsed well with fresh water and dried again. A second application of tartaric acid is made and the tanks are again dried, rinsed in fresh water, and dried. This treatment will remove the free alkalinity and thus prevent the neutralizing of the lactic acid formed during fermentation.

These tanks vary in size from an 8′ x 8′ (holding about 300 bushels) to an 8′ x 14′ (holding about 900-1000 bushels). Some object to the use of large tanks in salting on account of the heavy load, which produces quite a strain on the bottom unless properly supported. Most of the salting stations are frame buildings, or else just tanks erected in the open with perhaps only a roof over the receiving platform. This platform is about three feet below the top of the tanks and allows easy access when filling and emptying. Early and late in the season, when the receipts are light, small tanks are better, as they are soon filled and closed down. The method of handling and the volume of business should govern the size of tanks to be used.

Every tank should be equipped with a pump box, in order that the brine may be mixed properly whenever necessary, and also to permit the taking of samples of brine from various depths. A wooden pump box, fastened to the side of the tank is made from 4-6″ square, extending the full depth of the tank and having small holes at the bottom through which the brine can be drawn off, but small enough to prevent any pickles passing through.

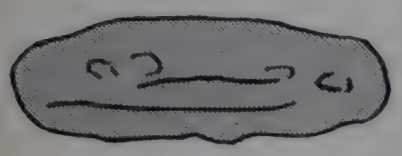
Wooden hand pumps may be used in small salting stations in order to lessen metallic contamination; but in larger stations motor or gas driven pumps of brass are often used. Iron pumps should be avoided, if possible, because of the danger of blackening pickles because of dissolved iron salts.

Wherever possible, the tanks should be raised high enough [illegible] the ground so that a man can get underneath to clean,

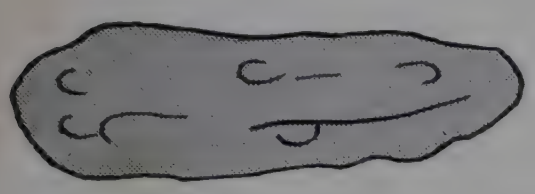
OFFICIAL SIZES FOR GRADING–5/6 ACTUAL SIZE

Used by special permission of National Pickle Packers Association

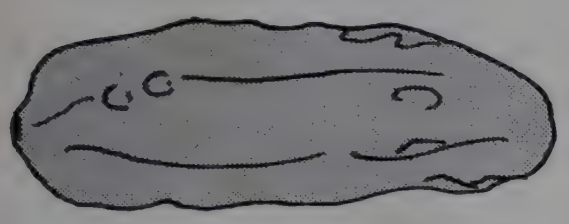
20,000 to a 45-Gallon Cask



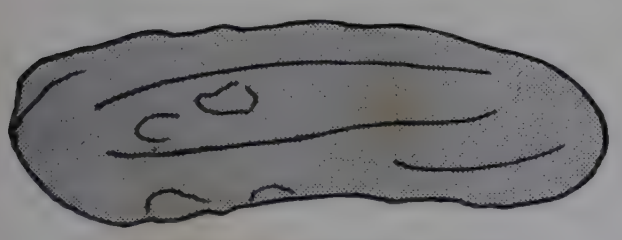
15,000 to a 45-Gallon Cask



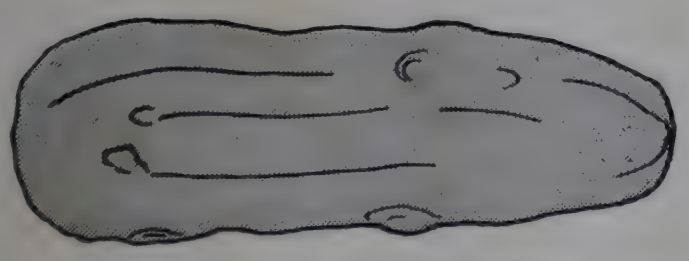
10,000 to a 45-Gallon Cask



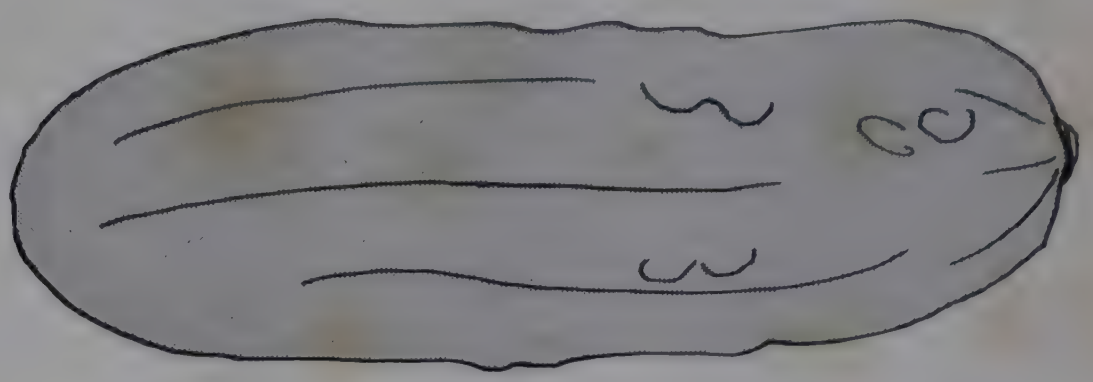
6,000 to a 45-Gallon Cask



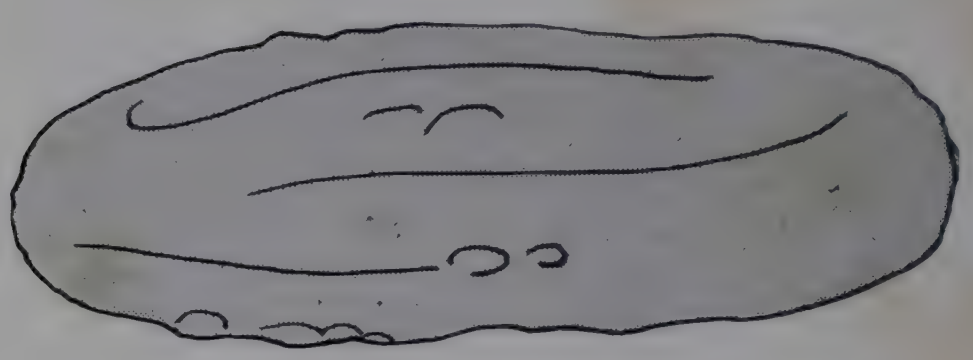
4,500 to a 45-Gallon Cask



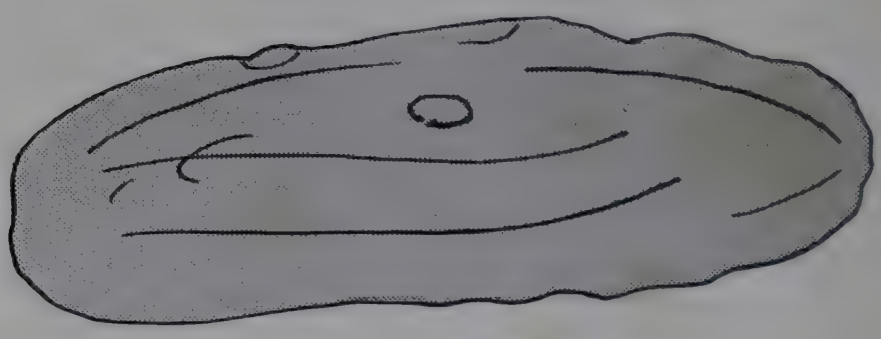
3,600 to a 45-Gallon Cask



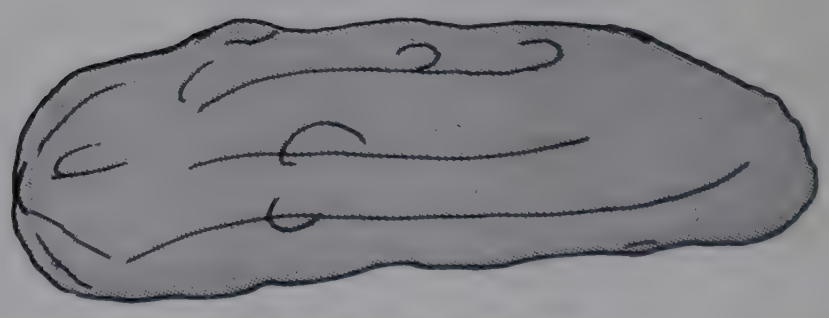
1,000 to a 45-Gallon Cask



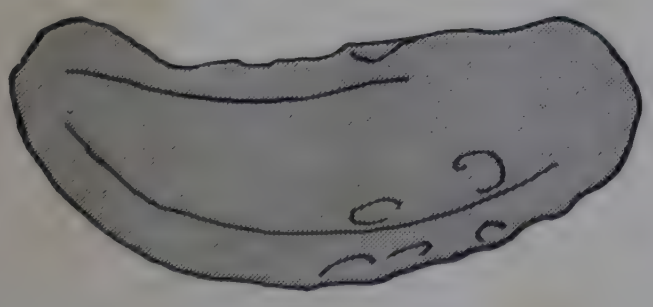
1,200 to a 45-Gallon Cask



1,800 to a 45-Gallon Cask



2,400 to a 45-Gallon Cask



CROOKED PICKLES AND NUBBINS

caulk any leaks, spray with disinfectants or even remove any debris that may accumulate. If a concrete flooring is not used, then cinders should be used, as they permit drainage and keep the ground comparatively dry.

In assembling tanks, care should be taken to caulk the seams and cracks with candle wicking. After soaking and being filled, the hoops should be loosened slightly to prevent the springing of the staves and the collapse of the tank.

Just before being used the tanks should be washed thoroughly and given a coat of whitewash. By the time the operator gets all the way around the inside of the tank, it is then ready to be washed off. If the lime seems to stick, it should be brushed off with a broom or stiff brush. The lime sweetens the tank by neutralizing any acid present, removes any organic matter, antisepticizes and deodorizes. If allowed to remain the lime may affect the fermentation as well as the skin of the pickle touching the side of the tank. Some prefer to sterilize the tanks after washing with a hypochlorite solution containing at least 50 ppm of available chlorine, but this solution must also be removed by thorough rinsing before pickles are placed therein. If it is not removed, an off taste may be imparted to some of the pickles and brine, and the color may be somewhat bleached, or it might check the natural lactic fermentation.

PROCESSING in connection with the handling of salt stock, means the removal of excess salt. This is done by leaching in water, whereby the salt is removed by the process of osmosis. In salting, the product absorbs the salt by the same process, whereas in processing, salt is removed by the reverse osmotic action.

A properly equipped tank should be used in processing, usually any round one about 3 to 4 feet high will answer. Pipe is placed on the bottom of the tank, in such a manner that a cross is formed by using a four-way steam tee, connected with ¾-inch perforated pipe. Perforations are about ⅜ to 1/3-inch and are spaced about 4 inches apart. If possible, it is advisable not to use any iron connections, on account of the rapid corrosion, which forms soluble iron salts that are absorbed by the pickles and may cause blackening later. Brass or brass pipe tinned can be used. The brass fittings may be attacked by corrosion and perhaps cause greening of the pickles. Some use fittings of rust proof iron, wooden or rubber fittings. But rubber could not be placed where steam is passing through as the rubber would soften. Cap the ends, and cover the pipes to prevent the pickles coming in direct contact with the live steam during the processing. Have one or two 2-inch drain holes in the tank, so that the water can be quickly emptied.

Others prefer an oblong tank 9′ x 5′ x 3½′ high with one-inch steam pipes coming down each end of the tank and running along the bottom to the center. The pipes in bottom were perforated with three rows of 3/16-inch holes spaced 2½ inches apart. To prevent direct contact of the pickles with the hot steam line a wooden housing, inverted V-shape, was made by nailing ⅞-inch boards together and placing it over the pipes. This housing had ⅜-inch holes bored three inches apart on each side of it.

FINISHING:—In making sweet pickles, there are several ways to proceed, depending upon the quality desired, time allowed, and capacity. To remove the salt, in making high grade sweet pickles, they are filled into barrels after processing, then rinsed, drained well and covered with an 80 grain cider vinegar. If the pickles are allowed to remain too long in the priming vinegar with uncovered tanks, bacterial contamination is likely to set in and cause soft pickles. In closed barrels, this is not likely to occur. Often by the time the vinegar has equalized, the acidity may be so low that con-

Priming the vinegar aids in crisping the pickles and removes organic matter that will cause a cloudy finished product. After standing 4 or 5 days in the priming vinegar, they are well drained and then covered with an unspiced sweet liquor containing 55% sugar and 5.5% acidity (55 grain white vinegar). After standing for at least three weeks, they are again drained and covered with a spiced sweet liquor which contains 62% sugar and 2.25% acidity. This makes an expensive high grade article. The first sweet liquor drained off the pickles is too low in acidity and sugar to be used again, as it can not be built up to the proper strength unless concentrated in a vacuum pan and then adjusted by the addition of vinegar and sugar. If evaporated in open kettles, the sugar will caramelize greatly. Some have built up the acidity with an 80% commercial acetic acid and added sugar to make the right strength. After the spiced liquor remains on the pickles for about a week they are then ready for use either for bottling or bulk.

The following results show the changes that take place in finishing sweet pickles:

Pickles after being processed were covered with an 8.0% (80 grain) vinegar and after standing 4 or 5 days, were drained. This liquor tested 3.30% acidity. The pickles were covered with an unspiced sweet liquor which tested—

Acidity	5.0%, or 50 grains
Sugar	55.4%

After remaining on the pickles for about 3 weeks (25 days) the liquor tested—

Acidity	3.72%, or 37.2 grains
Sugar	25.40%

This liquor was drained off and a spiced sweet liquor added which tested—

Acidity	2.2%, or 22 grains
Sugar	59.2%

Six months later tested—

Acidity	3.2%, or 32 grains
Sugar	38.0%

The pickles were firm, crisp, and had an excellent flavor.

In priming, a 65 grain vinegar may be used instead of the 80 grain with very good results, and many pickles even prime in a 45 grain vinegar.

The second method is to prime the pickles in 45 or 65 grain vinegar for about a week and then cover with a spiced sweet liquor that contains 50% sugar and 3.5% acidity. After remaining for about a week to 10 days, the pickles are ready for use. With only one sweet liquor, the sugar content is too low to keep under commercial conditions unless benzoate of soda is used. It really takes two sugar solutions to give the proper sugar content to the finished product. The sugar content of the syrup added is reduced to about one-third its original strength. About a 60° sugar syrup will, after pickles have remained in it a sufficient time to equalize, show a sugar content of approximately 20%, which makes a very good content for fermentation.

The third method is to place the processed pickles in tanks and cover with 100 grain vinegar to which spice oils or dry spices have been added and then to add sugar every morning and evening, taking about ten days to complete the process. The pickles should be stirred occasionally to prevent their becoming soft and flabby and to make a more uniform liquor. The pickles made by this process will not be a high grade product but will be fair. Unless care is observed in adding the sugar uniformly, flabby pickles result.

Every firm has its own idea as to acidity, sugar content, spicing, and method of manufacturing spiced sweet liquor. Plain sweet liquor is made by simply dissolving the proper amount of sugar in the proper strength vinegar. Cooking a

short time will start the inversion so that crystallization will not occur. Granulated sugar is preferable on account of its low mineral, low moisture, and high sucrose content. "C" sugar and brown sugars, which contain more molasses and mineral substances though not so high a sugar content, will usually give a slight molasses taste, a cloudy liquor, and a product containing mineral salts that aids in the fermentation process.

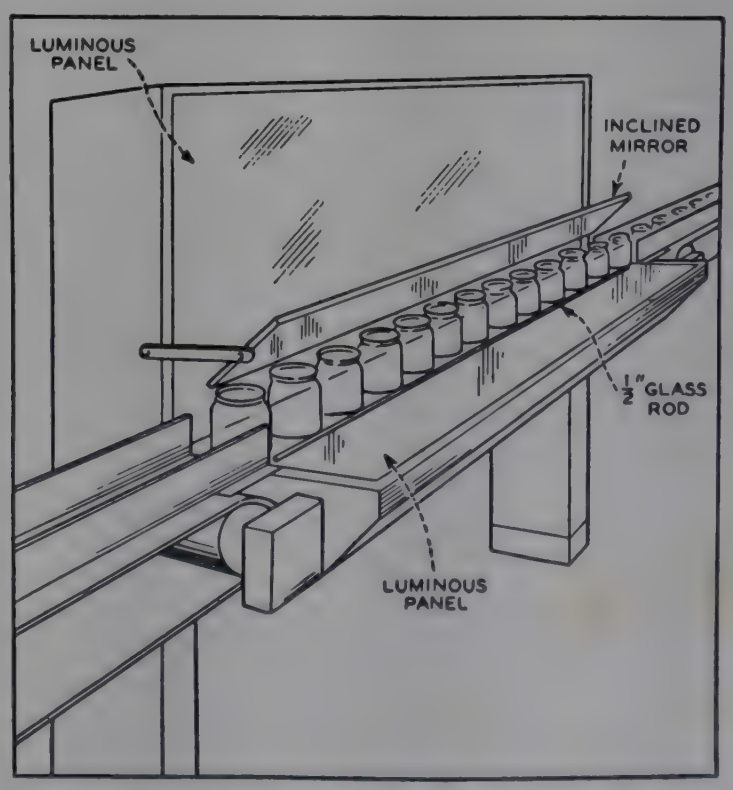
SWEET LIQUOR:—In making sweet liquor, several methods can be used. If possible it should be made in steam jacketed glass-lined tanks, in glass-lined tanks equipped with coils, or in wooden tanks with coils. Some picklers just run an open steam line into the tank for cooking the syrup. There are several objections to this method, as the steam line may introduce more water than is needed, and iron salts may scale from the steam pipes and later discoloration. If volatile boiler compounds are used in softening the water, they may also be introduced and produce an off taste. Live steam often contains oil from the engine. Copper kettles should not be used unless tinned, as copper is very easily attacked and dissolved by the vinegar. The amount dissolved may vary from a trace to such a quantity that it will produce a metallic taste and be objectionable. Any appreciable amount will impart a taste and color to the pickles even though no copper has been added; a sufficient amount often being absorbed to give a decided chemical reaction in the finished pickles. Cucumbers grown on soil containing copper will absorb a certain amount, and growing plants will absorb either metallic copper or their salts placed at their roots.

Should sweet liquor be cloudy or contain particles of wood or paper from bags or barrels, it should be strained through cloths, felt bags, or specially prepared filters. The liquor used to cover finished bottled goods should be as clean as possible. Two spiced liquors are seldom used, as one is sufficient to impart the proper flavor. Spiced liquor may be made by any one of three methods: first, by cutting the spice oils in strong vinegar; second, by cooking whole spice in vinegar; third, by percolating the whole spice with strong vinegar and then making the spiced sweet liquor therefrom. The spiced liquor made by the first method is not as good as that made by the other two methods. Spice oils may float on the surface of the vinegar and not be entirely soluble.

PACKING PICKLES:—Dills, sweet, sour and mixed pickles as well as special pickle products are packed mostly in glass, partly due to the idea that the housewife prefers seeing the type of pickle before she buys.

It is superfluous to state that all glass used for packing pickles should be washed so that dust, dirt and debris as well as any free alkali will be removed. It often requires a little ingenuity to properly arrange the pickles and other vegetables packed with them, to show up to best advantage because many packers are not quality producers but think only of sales volume and quantity production. But with the many new and beautiful glass packages offered now, there should be an incentive to pack quality goods. The cap selected should be picked for appearance, service and ease in opening. The proper liner should be used so the packed product or the vinegar from it will not come in direct contact with the metal of the cap and cause perforation. Of course, some caps are given an extra heavy coat of enamel which may protect and reduce or even prevent perforation. Many of the caps used on jars of dill pickles contain a felt back liner and an "oiled" paper disc which will protect and prevent "pinholing."

Packers of pickles in cans are apt to have more difficulty due to perforation, hydrogen swells, off-odor, discoloration, etc. then if packed in glass. However, many of the difficulties encountered are blamed on the cans when the trouble may be due to the raw material used, method of handling, improper sealing, etc. and the can maker is often unjustly condemned or criticized.



Glass jar inspection booth. Horizontal and vertical translucent glass panels are illuminated by fluorescent lamps behind. Mirror above containers gives inspector view of the inside of containers as they go by on conveyor line.

Section 3—Vinegar Making And Pickling

Chapter II—Processing of Vinegar

CIDER VINEGAR preparation of the apple juice or cider is purely a mechanical separation of the juice from the apples by means of grinders and presses. For cider vinegar, usually the run of the orchard, culls and windfalls are used; bad or rotten stock should be eliminated as they will often impart a musty taste to the cider and generators. The apples for vinegar are not usually washed, as there is wild yeast clinging to the surface and washing may retard the alcoholic fermentation, and permit undesirable changes to take place. Apples from orchards that have been sprayed with arsenic solutions to destroy disease should be washed in a dilute 1 percent hydrochloric acid solution and then rinsed thoroughly with fresh potable water, to remove the danger of poisoning. This treatment is especially necessary if the growing season has been very dry with little rain to wash off the spray.

The apple juice is placed in large vats to ferment. When fermentation takes place a "froth" or "head" forms on the surface of the liquid. This froth is composed of particles of apple pulp, skins, foreign matter, yeast mycoderm, etc. At first the gas given off will keep it up, but when the fermentation ceases, it will settle down through the liquid. It should therefore be removed to prevent its settling to the bottom and increasing the cloudiness. The juice from the press should be strained to remove as much as possible of the waste (small pieces of skin, apple, etc.). The cider from the press, after straining to remove coarse particles, can be centrifuged to remove the fine particles which remain in suspension. Some prefer centrifuging the fermented stock rather than the sweet cider. This is optional but there is no doubt that some wild yeast will be removed in such a process.

The cider will settle slowly when fermentation ceases, after which it may be siphoned or pumped off and blended in other tanks, while all dregs are collected in one tank and settled again. A clean and clear condition of the stock going into the generators minimizes the amount of trouble one will have, and all fermented stock should be strained or filtered. Clean stock produces clean vinegar.

After fermentation ceases and the tank has been skimmed, the surface can be covered with a thin layer of paraffine, or vegetable or mineral oil, to prevent the growth of foreign bacteria and loss by evaporation. If closed tanks are used, this is not necessary. The fermentation room should be separate and closed, and away from the generators to prevent the development of acetic bacteria before the tanks have completed the alcoholic fermentation and are ready to be generated.

OPERATION OF THE GENERATORS:—There are several effective methods of starting newly packed generators. The packing material should be impregnated or inoculated with active acetic bacteria. This may be done by running warm cider vinegar over the generator until it begins to flow from the outlet at the bottom. Distilled vinegar should not be used as the bacteria present in distilled vinegar have been developed under entirely different conditions, and may not be able to adapt themselves to the new environment of cider vinegar. Distilled vinegar would also be adding a foreign vinegar to the mix and could not be legally labeled pure. It is better to first run cider vinegar on the generators

recommend that the packing material be thoroughly washed with hot water to remove dust, soluble coloring, and wood extractive matter which will impart a taste to the first few hundred gallons coming through. Any water used must be replaced later by vinegar or stock, and this necessitates handling large volumes of weak vinegar. The results obtained are no better and it also increases the time required in starting.

Heat the vinegar to 125° F. by any available means such as coils dropped into the supply tank, and open all the air vents of the generator. Run the warm vinegar in rapidly until it comes out warm at the bottom, or until a good strong draft is created. The draft can be tested every few minutes while feeding the hot vinegar by holding a flame to the vent holes and noting how vigorously it is drawn into the hole. Great care must be taken when handling a light around generators, especially if packed with beechwood shavings, as the flame may be drawn in and the dry shavings take fire. When the vinegar comes out warm and a good draft has been started, shut off the warm vinegar and start a mixture of cold stock through. This stock is a mixture of about equal parts of cider vinegar and fermented cider. Close the air vent to ½ inch and feed the following quantities of mix. For a 4′x10′, feed 5 ounces per minute, and a 6′x16′, feed 6 ounces per ½ minute; continue to watch the air vents for free circulation and see that the feed lines do not become plugged or stop running.

Continue this procedure for about 24 hours, but watch the draft to see that it is still good. Whenever the acidity begins to show an increase, the feed should be slightly increased. Continue to watch the flow and draft for another 24 hours, checking the acidity to see if there is a greater increase. Should the draft seem to stop, it may be necessary to again warm the wash to about 100° F. Within 3 or 4 days the generator should be working normally.

ADJUSTING AIR-LIQUID FLOW:—When the vinegar runs off, and shows an increase in acidity, do not try to hurry the process by radical or sudden changes in either the air or the feed. Changes should be gradual and only every 24 to 36 hours. Should the acid and alcohol remain about the same for another 24 hours then it demonstrates that the air supply is only sufficient to oxidize a portion of the alcohol in the mix. Either the flow can be decreased or the air increased. As production counts, the logical procedure would be to give the generator more air and run the flow as rapidly as possible. Do this by giving a 4 by 10 foot generator two, ½-inch vents, and a 6 by 16 foot generator three, ⅝ and three-inch vents. Try this new air supply for another 24 hours. Tests of the run-off should show an increased acidity with a reduction of the alcohol present. The air supply may be increased at intervals of from 24 to 36 hours without changing the flow until tests show that the total run-off is composed principally of acid and very little alcohol. When the tests show that practically all of the alcohol in the wash has been oxidized, the operator should increase the flow not to exceed 20%, and leave the air supply the same. Should the run-off then show no change, or if the total is decreased by a slight reduction in alcohol, the feed should

air can easily convert the amount of alcohol present in the wash. If the total amount is decreased by a loss in both acid and alcohol, then the flow must be increased at once and the air supply slightly decreased. This is what is called over-oxidation, due ether to an excess of air or too little feed, especially the latter if the flow should stop or be greately checked by accident.

Lack of draft, is an indication followed by down draft, and if not checked will cause great internal disorder and stoppage of the acetification process. It may be necessary to flush the generator by increasing the flow threefold, plugging the air holes and even warming the wash in order to start the draft again.

A little experimenting with the air supply and flow will soon establish the proper amount of air and feed to obtain an efficient operating generator. Once this balance is established, no trouble should be encountered in operating as long as the composition of the wash or mix is kept constant. Too much stress can not be placed upon the fact that changes of flow and air should only be made about every 24 hours, as too frequent changes will cause serious disorders.

A hot solution is added to the generator for several reasons. It warms the interior, creating a draft, and causes the warm air to rise and form a suction at the vent holes when the cold air rushes in and rises. The acetic bacteria, which are found in the air, are drawn into the generator and partially inoculate the packing material, where they continue to develop and produce acetic acid.

TEMPERATURES:—Best results are obtained in operating when the weather is cold or the generator room is about 15-20° colder than the generators; in fact it does not matter how cold the room is kept, once active acetification has started. As the temperature at which the generators give the best results is about 80-85°, it is well to try and keep them as near this temperature as possible. When the atmospheric temperature during the summer months is from 90 to 100 F. it may be difficult to operate generators efficiently as they are easily affected and may slime very rapidly. It may be necessary to increase the flow greatly at this time to prevent over oxidation and to endeavor to keep the internal temperature as low as possible. The higher the temperature the greater the evaporation and the greater the loss of acidity as well as volume. Generators will operate quite well even in sub-zero weather.

Two mix or feed tanks should be used so that one can be refilled and mixed while the other is emptying. The wash used for the one run system is called the mix, because it is a mixture of vinegar and fermented cider stock. This blend can be made in any proportions, but for successful operation, it should be carefully made according to a fixed formula and kept constant. The mixes used for one run system usually consist of a mix that tests about 32.2 "grain" acidity and 2.88% alcohol by volume (23.0 "grain" acidity yield) and should produce a vinegar that tests 55.2 "grain" or 5.52% acetic acid.

GENERATING ACETIC ACID:—There are several systems of converting the alcohol into acetic acid. One method is to take the raw fermented stock and run it directly on the generators so that by checking the flow and regularting the air, complete conversion takes place. This method is not very practical, as the slightest disorder will throw the generator off. Another method is to run the raw cider stock over one generator and convert as much alcohol as possible; then to take this partly converted stock, run it on another either to completion or else subject it to a third generator to complete the acetification. Unless they are so arranged that the stock can flow from one generator to another, this method would require too much handling. The multiple run system is very seldom used for cider vinegar, and will not be discussed in detail. The same general rules and precautions apply to this method of handling. The fermented cider stock is run through the first generator, converting about one-half of the alcohol, the balance being converted in the second one.

The other method is called the one run or mix back system; this is the one most generally used. It consists of mixing fermented cider stock and vinegar then feeding it on the generators so that the alcohol is converted to acetic acid. The mix consists of about half vinegar and half cider stock; this proportion can be varied to suit the operator. The greater the amount of cider stock used, the slower the feed; and the greater the amount of vinegar used, the greater the feed. In a one run system, the same supply and receiving tank can be used for all of the generators; the feed or mix can be quickly and easily varied, should weather conditions or disorders demand changes.

Should it be desirable to subject the alcohol in the wash to a greater quantity of oxygen it can be accomplished in two ways.

1. Increase the air and keep the rate of flow the same.
2. Decease the rate of flow and do not change the air.

Whereas to obtain the opposite results, i. e., subject the alcohol to a smaller quantity of air, it can be accomplished by two methods.

1. Decease the air without changing the rate of flow, or
2. Increase the rate of flow with no change in the air.

After starting the generators, it is well to reduce the amount of air to the smallest amount necessary to oxidize the alcohol. Too much air will cause a too rapid oxidation or burning up with a loss in yield; too little air will cause the wash to flow through only partly oxidized. It is better to have too little air, as the unoxidized alcohol remaining in the vinegar may be converted when it again passes through in the next mix. A 4′ x 10′ will require about 2-quarter inch vent holes and 6′ x 16′ will require 4 half-inch holes.

The following amount of mix should be used:

4′ x 10′ will require about 75 gallons per 24 hours.

6′ x 16′ will require about 300 gallons per 24 hours.

The wash going on as well as the vinegar in the run off should be tested for acidity and alcohol and the sum of the acidity and alcohol in the wash should produce a definite acidity and alcohol in the finished vinegar.

Actual tests show that 2% sugar in the cider will yield about 1% alcohol, and that 1% alcohol will produce 0.8% acetic acid or 8 "grains." In making calculations to obtain the expected yields, the acidity of the fermented cider should also be taken and added to the alcohol yields. Example: Sweet cider tests 12.14% sugar and 0.66% acid, and should produce 6.07% alcohol, which would make 4.856% acetic acid (6.07 x 0.8) plus the 0.66% acid present, or a total of 5.52%.

Making calculations on the wash used to determine the yield would be:

Total acidity of the wash.....	3.22%
Alcohol (by volume) 2.875% (2.875 x 0.8) or	2.30%
Total acidity of the vinegar should be.....	5.52%

IRREGULARITIES IN OPERATING GENERATORS:—Some of the disturbances of a generator may be caused by the neglect of the operator or perhaps by some unforeseen cause that can be traced to mechanical troubles. During the day, the attendant is watching the generators and can detect trouble more easily and make the necessary changes. A great deal of trouble may occur at night when there is no attendant present. If a watchman is employed it is well to have him include the generator room on his rounds.

Unless the wash going on the generators is filtered or strained, it is likely to contain particles of slime or "mother" which may plug the feed line and spigots to such an extent as to slow the feed down materially or even stop. This slowing or stopping will cause over oxidation, as the air supply can convert or oxidize more wash than is being fed to it

and will therefore heat and "burn up" the alcohol. Should the feed line be plugged when the operator sets the flow, and the slime later be dislodged, this will cause an excess and run off only partly oxidized. Dirty wash and warm weather will cause the false heads to slime quickly, and the slime should be removed as often as is necessary.

All fruit juices used in making vinegar contain solids, protein, and mineral salts, which aid in the ready formation of slime or "mother." Any great amount of sliming will cause a disarrangement in the operation of the generator; first noticed in the air draught, which will be very poor, and an examination of the run-off will show an increase in the alcoholic content. If this condition is permitted to continue, the draught will finally cease and a down draught will set in and the wash come through unoxidized. The draught should be tried frequently and when it begins to slow down, clean the heads as often as necessary which may be every 4 or 5 days when they are working rapidly. A layer of clean straw is placed on top of the packing material to act as a filter and collect the slime, preventing it from working down into the generators.

Acidity tests should be made morning and evening on each generator, and one alcohol determination made on each of the generators as well as alcohol and acidity tests on the wash and runoff.

There should be plenty of mix on hand at night so there could be no possibility of the tank being emptied before morning. The feed lines and spigots should be cleaned regularly, either by means of water, steam or compressed air. When adjusting the flow, always open the spigot full for about a minute to dislodge any partices present.

Other causes for disorder in the generators may be that they are not plumb, or the distributing head not level, or there may be a looseness around the circumference allowing the wash to flow down the staves; also, the holes in the head may not be uniform in size or entirely free from slime, or the dump trough or sparge may leak or fail to empty properly, and evenly distribute the wash over the surface.

A "spotty" generator will cause irregularities. This is often caused by the generator head being out of plumb, dump trough not functioning properly, holes plugged, by the packing material matting, by channels forming where the wash runs through unoxidized or by compartments falling. It is advisable not to permit an attendant to get in on the packing material unless a platform is placed on it as the weight and tramping about on the packing material may cause spotty generators that will not operate smoothly, and may have to be emptied and refilled.

APPLE CHOP VINEGAR (so-called skin and core):—Formerly vinegar made from apple chops was labeled "pure cider vinegar" but a decision of the United States Supreme Court does not permit such labeling.

In making a vinegar of this character there is very little difference in the method of handling. The extraction and treatment of the juice being the only difference; the method of fermenting, generating, and clarifying are the same.

In extracting the juice, equip a tank with a false bottom, run in hot water, and add the chops, or cover the chops with hot water at the rate of 1½ pounds of chops per 1 gallon of water. Mix well and allow them to stand for at least 12 hours or over night. Do not boil. Drain well and again cover for 12 hours. Drain and use this second water on the next quantity of fresh chops as it will help to increase the sugar content. The chops can be pressed to obtain more juice, but the pressing adds pulp to the extract, and means another handling in case the residue is to be extracted for pectin. [illegible] evaporated skins and cores will produce 1 gallon of vinegar having an acidity of 4.0 grams per 100 c.c.

As the sugar content is low, the juice can be concentrated in an evaporator until it has a sugar content of from 11-12° [illegible]

It was customary to take the juice low in sugar, ferment it and add 100 "grain" spirit vinegar to give it the proper acidity before running on the generators. This last procedure of course is a violation of the law unless properly labeled.

The chops are not cooked, but simply leached or extracted; if cooked the juice would contain pectin, which would make the product viscous and colloidal and harder to handle. The pectin left in the residue can be extracted by boiling with water and a small amount of fruit acid and then used in making jelly; thus the entire product may be processed.

Chops are usually treated with sulfur fumes to bleach and preserve. The detection of sulfur or sulfates in the finished vinegar in amounts exceeding 7 milligrams per 100 c.c. would be considered an adulteration in vinegar not properly labeled as to its source.

As excessive amount of sulfates is not always an indication of "core and skin" vinegar because the water used in reducing the vinegar from generator run to 4.0 or 4.5% may contain an excessive amount of sulfates, so that the source of the vinegar must often be known in order that a false interpretation will not be made. However, there are some manufacturers who have sold "core and skin" vinegar for reduced pure cider vinegar and tried to place the blame for excessive sulfates on the water but when the average normal amount of sulfates in pure cider vinegar is considered as well as the sulfates in the water and the percentage of sulfates in the added water is calculated for the dilution the vinegar will still often show an excessive amount of sulfates that can not be accounted for other than from vinegar made from bleached cores and skins. Excessive sulfates in vinegar may be introduced from the coke used in filling the generators.

The table below are results on chops soaked in water (one part of waste to seven of water), pressed, fermented and generated in the laboratory:

APPLE CHOPS—VINEGAR

	Before fermenting Per cent	After fermenting Per cent	Resulting Vinegar Per cent
Total solids	8.522	2.000	1.430
Total acidity	0.330	0.375	3.750
Ash	0.291	0.238	0.222
Alcohol by volume		3.550	None
Brix	13.000		
Alkalinity ash 100 c.c. req. c.c. n/10 sulfuric acid	20.400	20.700	19.500
	Mgs.	Mgs.	Mgs.
Water soluble P_2O_5 in 100 c.c.	9.090	10.967	15.810
Water insoluble P_2O_5 in 100 c.c.	2.550	2.805	2.805
	Per cent	Per cent	Per cent
Pentosans (evaporated sample)	0.341	0.115	0.138
Pentosans (unevaporated sample)	0.359	0.102	0.154
Reducing sugars in per cent solids before inversion	59.340	12.640	19.280
Reducing sugars in per cent solids after inversion	45.900	16.680	

These results show that vinegar made from chops is likely to be low in acidity and would require the addition of 100 "grain" spirit vinegar, or the blending with pure cider vinegar of a higher acidity.

MALT VINEGAR:—One of the best flavored vinegars is made from barley malt. Any cereals may be used whose starch can be converted into sugars by malt.

The following proportions are often used in making English malt vinegar—malt 27.5%—barley 55%—oats 17.5%. Corn is cooked under pressure to break up the starch and then cooled and barley malt added to convert the starch to sugar; yeast is then added to this wort to ferment the sugar and change it into alcohol at the rate of 28 pounds per 2000 gallons of wort or "gyle."

Malt vinegar manufacturers endeavor to obtain a large percentage of fermentable sugar and low percentage of non-fermentable solids with the greatest amount of alcohol with little or no dextrine. After complete fermentation, the [illegible] is separated from the mash by straining and

filtering and then run on generators to complete the operation. In order to produce a 5% acidity in malt vinegar, it would require a sugar content in the wort of not less than 13% Brix or 1800 pounds of malt per 1000 gallons of water. The wort is cooled to 70° F. before adding the yeast, and after fermentation is over, cool to 40-45° F. and treat with gelatine to precipiate the protein. The gyle is often treated with enzyme solutions to remove the soluble proteins which may cause a cloudiness to the finished generated vinegar. The mash, being high in protein and fat, may be dried and sold as cattle food.

Malt vinegar made in England is sometimes too light in color consequently caramel color is often added at the rate of 5 pounds per 100 gallons. However, in our country such an addition will be considered an adulteration. This vinegar is treated the same as cider vinegar in order to clarify and filter so as to produce a clear product that will not cloud and have "mother of vinegar," eels, etc.

Malt vinegar has a tendency to become cloudy when exposed to air. This cloudiness is due to the proteins which may settle out when the product is heated.

The following are results on samples of pure malt vinegar:

Total solids	2.608%	2.440%
Total acidity (acetic)	5.120%	5.370%
Ash	0.275%	0.232%
S. G. at 15.6% F.	1.016%	1.0161%

SUGAR VINEGAR OR SYRUP VINEGAR:—Another source of vinegar is from sugars and syrups such as different grades of cane sugar, molasses and glucose. The general processes used are the same for fermentation, generation and clarification as are used for cider vinegar.

Molasses vinegar can be made by diluting the molasses to about 12° Brix, then add the yeast to ferment. In most syrups and sugar vinegars, it is necessary to add a small amount of acid to bring the acidity up to at least 0.2%, as the yeast is more active in an acid medium and fermentation is much better. After fermenting, operate the same as for cider vinegar.

SUGAR VINEGAR:—This can be made by dissolving 1 pound of sugar in every gallon of water used and adding enough acid to make it at least 0.2% and then add yeast (brewers-liquid) at the rate of 2 ounces per gallon. When the solution has completely fermented, handle the same as cider stock.

Here is the tank yard of a large vinegar manufacturing plant, where vinegar is stored prior to packaging or bulk shipment.

To produce an active and complete fermentation it may be necessary to add some sodium or ammonium phosphate and ammonium sulfate in small amounts to help the growth and development of the yeast so they can function properly.

There is a great variation in the color, sucrose, and moisture content of raw sugars, and in order to keep the product uniform it may be necessary to carefully blend several sugars, to obtain the proper color. Once a color is established or adopted, it should be carefully adhered to.

The following is an analysis of a raw cane sugar of medium color:

	Raw Cane Sugar
Moisture	0.333%
Ash	1.24 %
Total alkalinity of ash from 100 c.c. required c.c. n/10 sulfuric acid	89.00
Water—soluble ash c.c.	88.0
Water—soluble P_2O_5 in 100 c.c.	110.01 mgs.
Water—insoluble P_2O_5 in 100 c.c.	1.10 mgs.
Sucrose	87.74 %
Invert sugar	7.32 %
Total sugar	95.06 %
Ash insoluble in water	0.21 %
Lime—calcium oxide	0.129%
Sulfates	0.17 %
Magnesium oxide	0.072%
Sodium chloride	0.018%
Copper	8.0 mgs. per kilogram
Tin	19.0 mgs. per kilogram
Zinc	24.0 mgs. per kilogram

An analysis of sugar liquid made by dissolving 1 pound of sugar in 1 gallon of water:

	Gyle
Solids	11.591 %
Ash	0.135 %
Acidity	None
Total alkalinity of ash from 100 c.c. required c.c. n/10 sulfuric acid	20.4 c.c.
Alkalinity of water—soluble ash	12.0 c.c.
Total lime—calcium oxide	0.053 %
Water—soluble lime—calcium oxide	None
Sulfates	0.0169%
Water—soluble P_2O_5 in 100 c.c.	2.551 mgs.
Water—insoluble P_2O_5 in 100 c.c.	3.06 mgs.
Sucrose	9.47 %
Invert sugar	0.346 %
Total sugar	9.816 %

The following are results on vinegar made from raw cane sugar:

Total solids	2.422 %
Acidity (acetic)	5.370 %
Ash	0.232 %
S. G. at 15.6 degrees C.	1.0161%

ORANGE VINEGAR:—This can be made from the juice of cull oranges. The sugar content of oranges varies from 8-11% with an average of 9.5%, which means that if all the sugar is converted into acetic acid, it would contain only 3.8% acidity plus the acidity present in the stock.

Orange juice from frozen stock contains even less sugar so that the resulting vinegar would contain even less acid. In order to make vinegar from oranges, one is almost compelled to concentrate the juice before fermenting. Cull oranges are even more expensive than apples and such a product could not compete with the price of cider vinegar.

GRAPE OR WINE VINEGAR:—This vinegar can be made from any variety of grapes, and as they are high in sugar, the resulting vinegar will be high in acidity. On account of the high cost of grapes, they are not used very much. The following are some analyses of Concord grape juices and from the high sugar content, it can be easily seen that vinegar high in acid will result:

Total solids	22.235	22.33	21.97
Total acidity (tartaric)..	0.922	1.035	1.26
Alcohol	0.13	0.66	0.20
Total sugar (as invert)..	18.89	19.00	18.52

Vinegar resulting from fermented grape juice will contain about 7.0% acidity and about 2.0-2.5% solids.

Other fruits such as peaches, oranges, pears, pineapples, grapefruit, bananas and any small fruits can be used in making excellent vinegars, but like grapes, they are too expensive even when made from culls and waste fruit.

There may be many special districts or countries that have great surpluses of different kinds of fruits or vegetables rich in sugar that could be converted into vinegar. Waste bananas can be used to produce a vinegar with a pleasant banana flavor. Even the pulpy covering of the coffee berries can be fermented and generated with vinegar. Often waste honey is used. Unless the sugar content of the expressed juice tests 11-12% Brix, the vinegar produced may not meet the legal standard. If below 11%, it should be concentrated either in an open kettle or evaporator to the proper consistency.

PINEAPPLE JUICE:—The juice makes a vinegar with a pleasant taste and fine bouquet, but as the juice is low in sugar, it must be concentrated to at least 12% sugar before fermenting and generating. As a better price can be obtained for pineapple juice as a beverage, very little is converted into vinegar.

At canneries, where whole pineapple and the juice are packed, there may be an excess of the juice which has started to ferment before it can be handled properly. Under such conditions it might interest the packer to make pineapple vinegar with this waste.

DISTILLED VINEGAR:—This is a misnomer, as the product is not distilled but is made from alcoholic spirits that have been distilled. To manufacture this product, it requires special equipment and a permit to operate a still; therefore, details are omitted. The mash used may be made from any cereals whose starch has been converted into sugar, fermented molasses, glucose, or any product that has fermentable sugar. The process of generating is somewhat similar to that used in cider vinegar. Instead of running the mash through one large generator, it is usually run through three small ones, placed one above the other. Each converts one-third of the alcohol.

Where a company does not produce its own alcohol it is necessary to buy alcohol specially denatured with from 90 to 100-grain white distilled vinegar 50/50 for generating. To make such purchases requires special permits from the government, which keeps special supervision over the purchase and use. This prevents its divertion for illegal purposes.

As alcohol is distilled it contains no solids that the vinegar bacteria can utilize as food, the same is true of the vinegar mixed with the alcohol, so that it is necessary to add a slight amount of food to the wash going on to the generators. Whereas, fermented cider contains food solids such as phosphates, lime, chlorides, sugars, gums, etc., which are utilized by the vinegar bacteria. If the alcohol and vinegar contained foods then it would not be necessary to add anything to the [illegible] wash.

[illegible] the same size and style generators as for cider vinegar production or else three small ones placed one above the other may be used. The same packing material can be used, although [illegible] give very good results. The packing material should be [illegible] remove as much as possible of the color in the packing material, otherwise, the vinegar instead of being clear and colorless, may have a straw color. After the generators have been packed and ready to start, pass hot water through them containing 1 gallon ammonia per 1,000 gallons of water, until the wash water comes out clear and colorless. Then run in plain hot water to remove the ammonia. Test the wash water with phenolphthalein vinegar indicator, which will turn pink if the wash water is still ammoniacal. Also test the plain wash water going on the generators as it may give a pink reaction due to alkaline salts in the water. After washing with fresh hot water, drain well to remove the excess water.

STARTING GENERATORS:—Next heat 100-grain vinegar to not over 125 degrees F. so as not to kill the activity of the bacteria and pass it through the generators until it comes out warm at the bottom and shows a good strong upward draft of air at the vent plugs. If there is any doubt as to starting the generator, consult the section on cider vinegar—"Operating of the Generators." The generators are then ready to be fed the necessary wash.

The 100-grain vinegar used should not be heated too high so as to destroy the activity of the bacteria, nor should sterilized vinegar be used.

Wash

Mix		
400 gallons—100-grain vinegar	=	40,000 grains
180 gallons hot water		
1 bbl. (50 gal.) Alcohol—Vinegar (Mix 25 gal. 95% Alcohol and 25 gal. 100-grain vinegar)	=	2,500 grains
Total 630 gallons		42,500 grains
	or 6.74% = 67.4 grains and 3.77% alcohol	

This mix should produce, if only 0.9% acid is generated for each 1% of alcohol, 3.77 x .9 = 3.393% plus 6.74% or 10.133% or 101.33 grains.

This system is known as the mix back system where ⅔ of the wash is vinegar and the other ⅓ is alcohol. Operate the generator along the same lines as outlined under "Cider Vinegar." The white distilled vinegar generators should run with less formation of scum than the cider vinegar due to less food material present which causes the formation of "mother."

BACTERIAL FOOD—MALT SPROUTS:—Boil 4 pounds of malt sprouts with 4 gallons of hot water for a few minutes and then strain and use this solution.

Use 1 gallon of this for each 630 gallons of wash and add also 1 quart of a 50% glucose syrup. If the generators do not seem to work, then each can be given 4 ounces of honey diluted with water and 4 ounces of liquid malt sprouts occasionally until they warm up and appear to be working.

In addition to the above, a special chemical food is made up of the following:

Chemical Food

Water	25 gallons
Phosphoric acid (85% syrup).....	14 pounds
Potassium carbonate	4 pounds
Ammonia	4 pounds
Trisodium phosphate	3 pounds

Mix well before using.

Use 1 gallon of this mix per each 630 gallons of wash.

OPERATING THE GENERATORS:—The generators when started may be given an inoculation of acetic bacteria which have been specially grown in barrels for this purpose. This will pregnate the material in the generators so that acetic acid can be produced from the food and wash. About the same time the generators can be fed with a solution of

ounces of honey diluted with water as well as 4 ounces of the cooked malt sprouts. This food is added as long as the generators are cool and do not seem to pick up, but should be discontinued as soon as they warm up and are functioning. If the generators seem to get cold and not working properly, then the honey-sprout solution are again added.

Should the vinegar from the new generators run off with a high alcoholic content at first, it is again passed over the generators.

Follow out the system of operating cider vinegars and little trouble should be encountered. Test the acidity and alcohol daily, as well as the wash going in the generators, to see if they are operating efficiently. Keep a log book of the tests on the generators.

When slime or "mother" begins to form in large quantities on the distributing heads of the generators, the generator does not function at full capacity. Unless this scum is removed serious trouble is encountered which may slow down the generation or even cause the generator to cease functioning.

Add 1 pint of ammonium hydroxide full strength per 1000 gallons of wash or mix going in the generators for two or three days or until the slime disappears. Usually the generators slime up very quickly in hot weather so it may be necessary to clean the slime off more frequently.

HONEY VINEGAR:—Due to its high cost, it would be inadvisable to manufacture honey vinegar from honey. There are so many other cheap sources of sugar that it would not pay, unless the honey may be a waste product such as a fermented honey. In that case, it could be used, especially if a person is in the honey business and has considerable loss due to spoilage. However, it would pay to investigate the cause of the spoilage and use preventatives to avoid its reoccurrence because one can get a better price for honey with less effort than by making honey vinegar.

Honey contains about 70-80% sugar. When fermented properly it should be a very good source for alcohol. Since it contains very little ash (mineral matter), it may be necessary to add some minerals as food for the yeast to develop and produce alcohol.

Honey should be stored in a dry cool place and if stored where it is damp, it may absorb sufficient moisture to permit the wild yeast present to start fermentation. Where the honey has fermented, the flavor has changed somewhat so that the honey cannot be cooked to destroy activity and still be of highest quality. When honey is used for vinegar, often the fermented stock as well as washings from the strainers, etc., are used. Make a solution of honey to contain about 15% sugar. Then boil this solution slowly for 10 minutes to destroy the wild yeast present. Cool, and add some cultivated yeast and when the solution tests zero or 1° Brix the fermentation is over. Allow the liquid to stand in closed vessel several weeks to settle or clarify before generating and then handle the stock the same as cider vinegar.

GARLIC VINEGAR:—This can be made by boiling 5 pounds of ground garlic buds in 10 gallons of 40-"grain" vinegar for about 5 to 10 minutes. Allow it to age for several days before clarifying and filtering, if the product is to be sold.

SHALLOT, CHILI, TARRAGON, and other spiced vinegars can be made in the same manner as garlic vinegar. Boil for a short time 2 ounces of spice for each gallon of 40-"grain" spirit vinegar. Allow it to age, then filter, bottle and the product is ready to sell.

Section 3—Vinegar Making And Pickling

Chapter III—Processing of Pickles

SALTING

THERE are two general methods of salting cucumbers; first, dry salting; second, brine salting. Both methods will be discussed, but the dry salting method seems to be more antiquated and not used as much as the brining method.

Dry salting may cause soft flabby pickles that will not fill out upon processing. This may be due to improper scattering of the salt, but more probably is due to the rapid osmosis of the water, sugar, etc., from the cucumber, which causes shrinking or flabbiness. The fact that the tank will probably hold from one-fourth to one-third more pickles would scarcely justify its use when we consider that a superior quality can be obtained by the brine method.

To prevent the pickles from being bruised, broken, or smashed by their own weight when first dumped into the tank, about 8" of a 40° salt brine is placed in the tank before adding any cucumbers. This brine should be made up, if possible, several days before being used in order that the temperature may be about that of the salting station. As well water is often used, its temperature is usually quite low. Cold water or cold brine will retard fermentation. If the water could be heated to 85° F. when used in making brine it would be ideal because that is the best growing temperature for the lactic bacteria.

In making brine, an open headed barrel may be used. A water inlet pipe enters the barrel near the top and runs to the bottom, and the outlet pipe which is larger, is at the opposite side and near the top of the barrel. The salt is placed in the bottom, and as the water passes through and upward, it agitates the salt and dissolves it quickly. Fine salt should be used as it dissolves quicker. For convenience, the barrel may be mounted on a small truck, so it can be easily moved about the plant.

A water meter that has direct gallon readings is most convenient for accurate work, not only for salting stations, but also for any food factory, in gauging all tanks, containers, kettles, etc.

An 8' x 8' tank will require approximately 219 gallons of water and 205 pounds of salt to make 8" of a 40° brine; and an 8' x 14' (diameter) will require about 685 gallons of water and 600 pounds of salt to make 8" of a 40° brine.

A bushel of pickles is considered to weigh 50 pounds.

One cubic foot of water is equivalent to 7.48 gallons and weighs 62.3 pounds.

One pound of salt added to one gallon of water will make a 40° brine and 14 ounces will make a 38° brine.

DRY SALTING:—Make from 8-10" of a 40° brine in the tank to be used. While adding the cucumbers, distribute carefully and uniformly, 50 pounds of salt for each 20 bushels (or 1000 pounds) of cucumbers for small sizes and from 60 to 65 pounds for large sizes. Lack of proper distribution will often cause flabby pickles. The salt draws the water from the pickles by a process called osmosis, thus making the brine that covers them during the process of fermentation. When through receiving for the day, cover the cucumbers and weight them down so the brine will cover them. After [illegible] to make a uniform surface, cover with [illegible] to the proper circle, and hold it down with 2 x 4's anchored to the sides of the tank or else by using open headed barrels filled with water, so they can be quickly emptied by dipping with buckets or siphoning. Should the brine be within a foot of the top of the pickles when the head is put in place and keyed down, it will hardly be necessary to add any brine as the cucumbers absorbing the salt will become heavier and gradually sink under the liquid. If the brine should not cover the pickles when the head is properly weighted down, then cover with a 40° brine.

In closing a tank, fill it level full with cucumbers, put the cover in place and weight down with water casks so there is about 6" of brine above the cover, then fasten in place securely with 4 x 4's anchored to the sides of the tank with large iron hooks or clamps.

At the expiration of three or four days, add 40 pounds of salt for each 1000 pounds of cucumbers or enough salt to bring the brine up to 40°. Scatter the salt evenly over the cover; it will dissolve slowly and gradually sink to the bottom. At the expiration of two or more days, add 40 pounds more for every 1000 pounds of cucumbers. Do not allow the brine to fall below 40°.

The tank should be pumped in about a day or two after filling, in order to equalize the brine, but should not be pumped again except for some special reason. If the tank is very slow in starting, some very active brine should be added and mixed thoroughly by pumping, so as to inoculate the tank. The lactic acid group, which causes the pickle fermentation, is probably from the soil where the cucumbers and other vegetables are grown. Thus the inoculation occurs even before they are placed in brine.

The lactic bacteria found in pickle fermentation are usually long, slim rods. While they are not strictly anaerobic, yet they develop far better when oxygen is excluded. Thus it is well not to pump the tanks and introduce oxygen which is essential to the growth of bacteria, but not essential to pickle fermentation. Pumping may also mix these organisms throughout the tank. The best temperature for the growth of the lactic bacteria seems to be about 86° F. Therefore, if warm water could be used in brining, the active fermentation would be greatly accelerated.

The strength of the brine should be gradually increased, so as not to check the active fermentation. Increase it 2° each week for five weeks or until it tests 50° and then 1° each week until it tests 60°.

BRINE SALTING OF CUCUMBERS:—The majority of the large salting stations use the brine process of fermenting pickles rather than the dry process. Some prefer the addition of a 40° brine rather than adding salt and water to make the brine.

In filling a tank, first make a 40° brine several days in advance, if possible, so as to allow it to warm up. This brine acts as a cushion to prevent the pickles from being bruised or broken when filling the tank. The general procedure in filling large tanks is to add salt at the rate of 2 pounds per bushel of pickles after the first 300 bushels have been added, uniformly scattering the salt. The amount of salt per bushel may be varied, some salt at the rate of 3½, 4, 4½, 4¾, and 5 pounds per bushel and may use 14, 15, or 16 ounces of salt for every gallon of water used in covering the

cucumbers. The tank is filled with cucumbers and the salt added at the rate of 2 pounds for each bushel of pickles and the remainder of the salt (i.e., the difference between the amount determined upon and the two pounds used) is spread on top of the tank-cover. Water is then run on from a water meter until the pickles and salt are covered.

For accuracy and checking, it is advisable to weigh and measure everything going into the tank. The hose outlet from the meter is kept in one spot so that the salt will not be washed to the bottom of the tank, thus making the brine test stronger. The amount of salt necessary for the water just added is calculated and added to the top of the tank. The tank is undisturbed until the next morning, when it is pumped until all the salt has been dissolved and both top and bottom brine test the same. Some prefer not to pump the tanks at any time so as not to disturb the fermentation.

In order to distribute the brine more uniformly as it comes from the pump, it may be run down a triangular trough arranged with notches or holes at the bottom, spaced every two feet, to allow the brine to run through to the top of the tank. The tank seems dormant for two or three days with occasional bubbles of gas rising to the top, but if the top cross pieces holding the cover in place are struck a violent blow, considerable gas is given off.

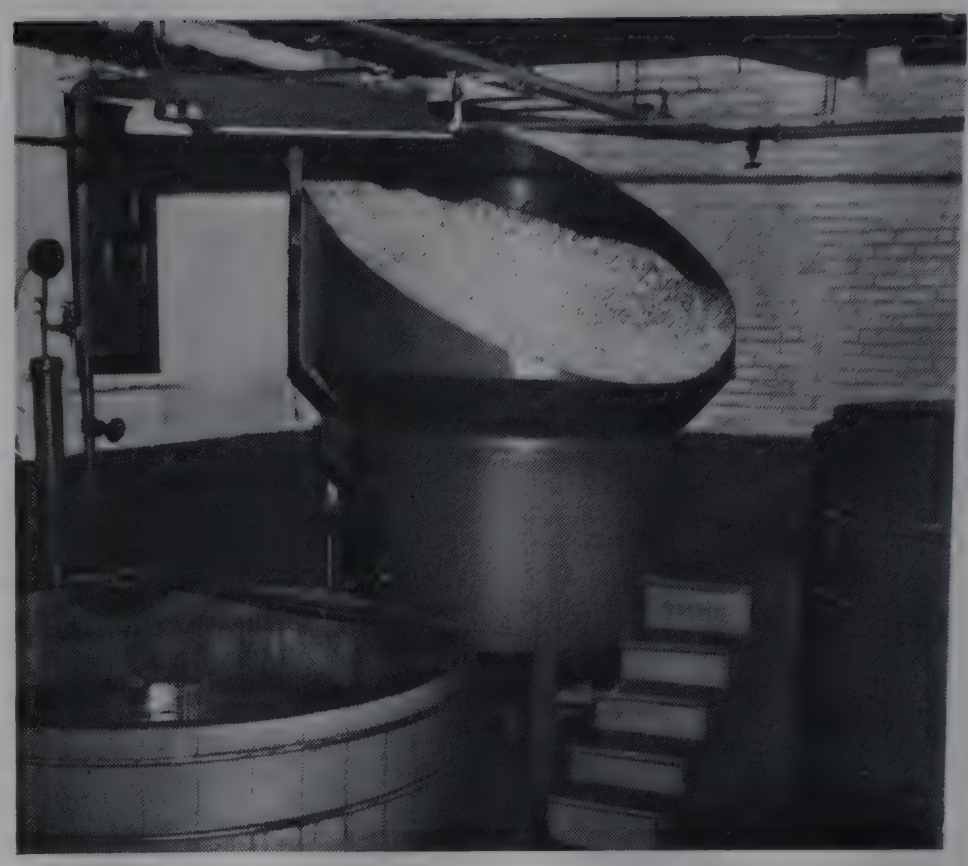
SCUM:—After several days a gray film covers the surface; this film or scum increases until it is from one-eighth to one-quarter inch thick and is rough and wavy. It is grayish white at first and turns cream color after remaining on the tank for about a week. Care should be observed in removing this scum, not to break it up, and scatter it through the brine. When examined with a microscope, it will be found to be a mass of wild yeast and some bacteria. If this scum is permitted to remain on the tank, it will reduce the acidity of the brine, become putrid and scatter through the brine, setting on the pickles and permitting the undesirable putrefying bacteria to develop and cause spoilage by softening and decomposing them into a mushy condition with a very disagreeable odor.

This white scum or mycoderma has a chalky appearance at first and later becomes creamy. A pseudo yeast it is named **mycoderma cucumerina** or **mycoderma vini.** It is highly undesirable because it utilizes the acid formed during the fermentation, decomposing the acid into carbon dioxide and water; and after the acid has been consumed, the destructive bacteria increase enormously and cause soft, mushy, rotten pickles.

Microscopic examination of brine taken from different parts of a tank at various times revealed the presence of active yeast and bacteria. Very few yeasts were found near the bottom as they are aerobic and require air, but countless active bacteria were present. Bacteriological examination revealed the presence of many different types of bacteria such as are commonly found in the air, and on vegetables, but the lactic predominated. Lactic acid is destroyed very rapidly by wild yeast; mold also aids the yeast in this destruction. Thus the necessity of removing this scum. Cucumbers salted in tanks out of doors do not develop this film or scum, as darkness is necessary for the growth of the yeast mycoderma.

While some recommend the washing of cucumbers before brining, others are adverse to such a procedure. The cucumbers often sweat a little after being picked; yeast, lactic and other bacteria floating about in the air cling to the moistened surface, thus getting into the brine. Washing would probably remove the lactic bacteria, and may permit putrefying or foreign bacteria to predominate rather than the natural organism, especially if the tank is slow in starting to ferment.

Cucumbers are properly cured by the lactic bacteria. A bacteriological examination shows the presence of many different types of bacteria and wild yeast. Pickles contain



Handling & spillage of salt are greatly reduced with automatic brine maker (cutaway view above). Equipment makes uniform brine from dry salt, pumps it to place of use in the plant.

about 2.5% of invert sugar, as well as mineral salts, protein, etc., and the osmotic action when the cucumbers are placed in salt brine leaches out the sugar, replacing it with salt solution. The sugar, being in an easily fermentable state, is readily acted upon by the bacteria which produce lactic acid. Should the yeast fermentation predominate at the beginning, then a very small amount of alcohol, probably not exceeding 1.5-2.0%, may be formed. This alcohol has no preserving effect, so that foreign bacteria would immediately attack the tissue of the cucumbers and break it down, resulting in soft, slippery pickles. In addition to the lactic acid, acetic, and butyric acids and alcohol are often produced in small amounts.

It is usually about two days before any noticeable fermentation has started and the acidity increases from about 0.05 to about 0.7% in from 3-5 weeks. There seems to be more gas produced in about ten days and active fermentation continues for from 3-5 weeks, when it seems to diminish. The lactic acid group which is present in pickle fermentation does not produce gas. The gases may be caused by some slight alcoholic fermentation by the yeast or other bacteria, air being driven out of the cucumber by osmosis or cell respiration, giving off CO_2 (carbon dioxide). In experience, the acidity never exceeded 0.75%. Should a higher percentage of acid be desired, it can be produced by adding from 1-2% of glucose or any other cheap fermentable sugar when making up the brine.

The addition of too large an amount of sugar may cause the wild yeast to develop first and predominate, and use up the sugar so the lactic bacteria have no food for their growth. It would be better to add the glucose, dextrose or sugar after fermentation has started actively by taking just sufficient brine to dissolve the sugar and add it to the tank. If the sugar is added when salting, the yeast might be encouraged to develop rather than the lactic bacteria. About 2 pounds of dextrose per barrel of pickles is often added, but some even increase it to as high as 5 pounds per barrel.

The fermentation usually ceases when all of the available sugar has been consumed or converted to lactic acid, alcohol, etc. Cold weather may check or retard the fermentation so that it may not be completed until the following spring. The addition of sugar will increase the cost, as well as make an additional step in the method of handling, which is not usually done commercially. Lactic acid acts as a germicide on the

lactic bacteria, so that they either become dormant, or die when the acidity gets above certain limits. Lactic acid will prevent the growth of putrefying bacteria, but if the acidity of the brine should be low, then decomposition is likely to set in.

Since the formation of lactic acid is the natural sequence of pickle fermentation some have thought that the addition of lactic acid in small amounts might be beneficial to cucumbers during the early stage of their fermentation. The results of such tests do not substantiate this. The cucumbers cured just as quickly but the acid seemed to upset the fermentation. Even with dill pickles, the results obtained were the same.

If possible the acidity should be kept at about 0.6% lactic and should it decrease to about 0.2%, decomposition will take place. If the percentage of salt is low, decomposition is also likely to take place; it should never be below 35°; 40° and upward being better.

The results of a series of experiments on salting a number of tanks of pickles, show that from 6-8% salt is absorbed in 24 to 36 hours and about 10% in 3 weeks. The liberation of gas, due to fermentation, undoubtedly prevents some absorption of salt, as the brine tested 47° while the salt in the pickle tested 10% or 40°. The rapidity of the fermentation depends upon the salting, percentage of sugar present in the cucumber, atmospheric and tank temperature. A low brine favors a rapid fermentation while a strong brine retards. A moderate fermentation is more desirable, as the pickles absorb salt more slowly and remain plump and crisp. In case of a rapid fermentation, the liberation of gas preventing the proper absorption of salt may cause a too rapid absorption at once, so that the pickles become soft and flabby. It is often necessary to check a too rapid fermentation in hot weather by the addition of salt. This addition should be gradual in order not to check too rapidly the lactic fermentation.

When fermentation is very slow in starting, especially in cold weather, some brine from an actively fermenting tank can be added. Pump the tank so that the lactic bacteria are well distributed, and active fermentation will usually start. On account of the great care in handling pure cultures for inoculating tanks, it is deemed neither practical nor advisable. The results obtained will hardly justify the time, effort, and great care necessary. To be of any value the cultures must be handled carefully by persons of experience. The person in charge of a salting station is too busy attending to other details to give it the proper attention. Often the workers are only employed for a short time, naturally they do not take the interest that a permanent employe would.

Nature having inoculated the cucumbers, the natural fermentation will progress properly if given a little assistance.

Pickles are cured when they have lost their bright green color and have changed to a dark brownish (olive) green or yellowish green. When broken, the pickles show no white spots, are translucent and no longer chalky white and opaque but uniform in appearance. After fermentation, the pickles should be allowed to remain in the tank for at least three months or longer before being used. Often fermentation is retarded by extreme cold weather, but if the cucumbers are allowed to remain in the tanks, this fermentation may be completed later. Pickles kept in brine for several years were of a very fine quality when removed and examined. Many manufacturers will not use pickles for sweets, unless they are at least one to two years old.

A person salting pickles using a brine lower than 40° is very [illegible] to have spoilage. Should the brine test from [illegible] spoilage is almost certain.

After fermentation is over, some protect the tank by excluding the air from the surface, thus preventing the inoculation by yeast and foreign organisms. This is done by pouring hot melted paraffin over the top of the tank so as to [illegible] exposed surface. Others

A pickle salting station, in a growing area, where cucumbers are held in brine up to several months before processing.

pour a tasteless mineral oil or salad oil over the surface.

A permanent and accurate log should be kept of each tank, so that at the end of the season a careful check will show the actual pounds of pickles, salt, and gallons of water used. This book should also contain records of the tests made on the brine, as to the percentage of salt, acidity, brine temperature as well as atmospheric, and any other data that may be of interest. These records are available in arriving at the cost of the raw materials, etc.

SOFT OR SLIPPERY PICKLES are caused by improper handling. The tank may have sprung a leak and exposed the pickles to the action of decomposing bacteria; or the brine may not have been kept up to 40°; or perhaps the cover may have been broken and the pickles exposed to the air; or again the acidity may have dropped to about 0.3%. This slippery condition may contaminate other pickles and cause considerable loss. The organism causing this spoilage is often due to the **Bacillus Vulgatus,** sometimes called the potato bacillus. It is a member of the mesentericus group, is found widely distributed and may grow either in acid or alkaline solution of pH 3.8-7. No treating will bring a soft, slippery pickle back to its normal condition once it has become bad. Added salt will not cure the trouble, but salt and lactic acid may keep the others from becoming soft. Whenever this condition is noted the pickles should be sorted at once and the bad ones removed and destroyed and the others watched carefully as they may be just starting to spoil. Do not place the sorted pickles from contaminated tanks with good pickles as you will no doubt inoculate the good and have a greater spoilage.

ROPY OR SLIMY BRINE is another contamination that may occur in salting. Ropy brine is a bacterial contamination which occurs when the acidity of the brine is low and also when the salt may be low. In order to get rid of this condition and obtain the lactic fermentation, part of the ropy brine is drawn off and replaced with brine from a very active tank. Pump the tank in order to mix thoroughly. It has sometimes been necessary to remove all of the brine and replace it with a mixture of active brine and new salt solution to start the tank fermenting.

It has been found that by increasing the addition of the salt rapidly the ropy condition disappears. Instead of increasing the salting of the pickles 2° each week for five weeks and then 1° each week for ten weeks more, as outlined in the procedure for salting pickles, just double the amount of salt added each week. This additional salt should not be added all at once, otherwise the fermentation may be checked too rapidly thus preventing the formation of lactic acid which is so necessary.

If the ropy brine is entirely removed from a tank of pickles, then the soluble sugars, nitrogenous materials are thrown

In this plant, "bread and butter" pickles get a test from production management, as girls with gloves packs them.

away, thus making it harder to obtain the full amount of lactic acid so necessary to preserve the pickles. This ropy condition as reported by salters usually occurs during the hottest period, usually when the days and nights are both hot and the tanks just "closed down."

FLOATERS OR BLOATERS occur during the fermentation of large hollow pickles. This condition may be overcome, if the hollow cucumbers are punctured with an awl, or knitting needle, or some pointed instrument. This will allow the release of gas produced by fermentation so that it can be replaced by the brine. A machine has been made to prick the cucumber mechanically so that the salt will penetrate more quickly, permit the fermented gasses to pass out and aid in their curing. It is motor driven and the cucumbers are fed to it automatically, thus saving hand puncturing. Improper methods of salting are thought to cause this trouble. Bloaters can be used for cut pickles or pickle relish.

SALTING OTHER VEGETABLES:—In packing pickles to make an appetizing and attractive product, the addition of other vegetables is quite essential. These products must also undergo a preliminary fermentation, the same as cucumbers. The vegetables used are onions, cauliflower, green and red peppers, tomatoes, beans, mango, melon, cabbage, etc.

As these products are not received in such large quantities as cucumbers, they are fermented in small tanks, olive casks or barrels.

In salting vegetables, especially if one does not wish them to cure out by the fermentation process, the vegetables are put into barrels. About 6 pounds of salt and about 1 pound of calcium chloride are added, and then the barrel is filled with 50 to 55-grain vinegar. The calcium chloride is added to preserve and harden the vegetable tissue, principally the latter. Vegetables handled in this manner may keep indefinitely if kept cold, but usually when the barrels are brought into a warm place, lactic acid fermentation may start. When this fermentation has started, the lactic acid formed during the fermentation seem to aid in the formation of insoluble calcium salts, which forms a white sediment or precipitate. This precipitate may increase to such an amount as to produce an unsightly product, or may form as hard white spots or nodules on the vegetables,—sometimes where they touch the barrel or glass containers. The greater the amount of lactic acid formed, the greater the precipitate As lactic acid has a preserving effect and prevents the softening or decomposition of vegetables, the lower the amount present, the more likelihood of spoilage. In fact, all of the lactic acid may be neutralized by the calcium chloride, or combine to form calcium lactate.

SALTING CAULIFLOWER:—Cauliflower undergoes the same process of fermentation as cucumbers. As it contains more sugar, protein, and mineral substances, the fermentation should produce more lactic acid. The average composition of cauliflower is:

Moisture	92.3%
Protein	1.8%
Fat	0.5%
Total carbohydrates and fiber	4.7%
Fiber	1.0%
Ash	0.7%

Methods of salting, weather conditions, etc., control the fermentation the same as cucumbers. The green outer leaves are first trimmed off and the cauliflower heads placed in tanks and salted at the rate of 4¾ pounds of salt per 50 pounds of cauliflower and 14 ounces of salt for every gallon of water used. The tanks are handled in the same manner as in salting cucumbers. Close the tank down at 38-40°; pump the next day and do not disturb again unless absolutely necessary. Gradually increase the strength of the brine 2° each week for five weeks until the brine tests 50 and then 1° each week for ten weeks until it tests 60°. To keep the cauliflower firm and crisp, the salt is increased until it tests 80° and held at this strength. The higher the brine the firmer the product.

Active fermentation will start in about two or three days and last for about five weeks. The acidity is a good check on active fermentation.

Instead of fermenting the cauliflower, it is often held in a 60° brine or stronger, until it becomes crisp and cured. It may be placed in barrels and salted at the rate of 5 pounds per 100 pounds of cauliflower; after remaining several days in this weak brine, it is rebrined at the rate of 8 pounds per 100 pounds of cauliflower and gradually increased until it tests 60°. The first salting leaches out some of the sugar and objectionable vegetable matter; and helps to produce a whiter and crisper product. To produce 250 pounds of cut cauliflower, it will require 302 pounds of cauliflower heads. Some trim off the green outer leaves, then blanch in a boiling water bath containing 2% citric acid, or in a salt brine of 1½ pounds of salt for each 12½ gallons of water, after which it is placed in tanks and salted as outlined under pickles.

SALTING ONIONS:—The following is the average composition of onions:

Water	87.6%
Protein	1.6%
Fat	0.3%
Total carbohydrates	9.9%
Ash	0.6%

Being high in sugar, protein and mineral substances, onions if fermented properly, should have a very active fermentation and produce a high acidity. Onions to be salted should first be dried and the rough outer skins and adhering dirt removed before they are placed in salt solution. To eliminate onions having a strong taste, soak several days in cold water. This soaking will remove the objectionable juice which may cause the brine to become dark and putrid and also loosen the earth clinging to the roots. Run off the water and add fresh water to which has been added 4 pounds of salt for every bushel of onions. This will further leach out the strong taste and help to produce a whiter product. In about four days again drain and cover with a fresh 60° brine; they will then become firm and crisp. This brine may be increased to 80°, especially if they are to be kept any length of time.

If the above method is not convenient, proceed to handle the same as cucumbers. After trimming the stem and root ends, place the onions in a cask and add 4¾ pounds of salt for every 50 pounds of onions, and one pound of salt for every gallon of water used in covering. Pump the tank the next morning to equalize the brine and then slowly increase the brine at the rate of 2° each week for 5 weeks and then 1° each week for ten weeks until it tests 60°. If they are to be

A semi-mechanized pickle packing operation, in which pickles are carried to long packing line by a series of conveyors.

kept any length of time, increase the brine to 80°.

SALTING GREEN TOMATOES:—Cold weather may check the development of tomatoes so that they will not ripen. To prevent a total loss to the grower, they are picked and processed the same as cucumbers, or else used immediately for making piccalilli. They have a very good flavor and are often used in relishes. They may be converted into "dill tomatoes" which are indeed very appetizing. For method of pickling as dills, pack them the same as for dill pickles.

As the quantities received are rather small, they are processed in barrels or small tanks.

PEPPERS:—Among the newer condimental products placed upon the market by manufacturers are peppers—sweet and hot—packed in vinegar. For sometime pimiento peppers have been packed in cans for household use in garnishing foods, especially salads, yet the packing of pickled hot and sweet peppers in glass is recent.

Peppers are usually shipped to market in tall hampers or bushel baskets and if transported any great distance, should be handled in refrigerator cars.

Growing on sandy soil as a general rule, peppers have considerable sand clinging to their skin and in order to pack high class peppers they should be washed thoroughly with fresh, clean potable water. A cylindrical rotary washer such as used in washing tomatoes or corn, could be adapted for this work by using a smaller screen. Owing to the large mesh used in the average fruit and vegetable washers, peppers will fall through and be caught and torn to pieces but by using a smaller mesh this trouble can be obviated. A rotary washer is preferable because the peppers turning over and over are thoroughly cleaned whereas a straight washer in which they are not turned is not so effective. After washing, they should pass along a perforated belt to drain the excess water which will dilute the vinegar.

The peppers are then placed in clean, well-coopered barrels. To each 50 gallon barrel of peppers are added 10 pounds of salt and after being headed, fill with a 50 grain white distilled vinegar. Some add 1½ pounds of calcium chloride to each barrel of peppers to preserve and crisp them. Calcium chloride should never be used in packing raw vegetables that are undergoing active fermentation because a white precipitate [illegible] is formed and white spots may form on the [illegible] vegetables. Instead of using calcium chloride [illegible] "pickle" alum at the rate of 2 pounds per each barrel of peppers. Some prefer packing with 15 pounds of salt per each barrel and covering with a 55 grain white dis- [illegible] of 50 grain of calcium chloride. Some prefer heating the "brine" or "vinegar-salt solution" to 190° F. before adding it to the barreled peppers.

Experimental packs with calcium chloride, "pickle" alum, and plain (no alum or calcium), showed conclusively that peppers packed with calcium salts produced white spots on the peppers but little or none when packed plain or with alum. When the peppers treated with the calcium were repacked and covered with vinegar, almost without exception, a heavy white precipitate formed and made the product so unsightly as to be unsalable.

The filled barrels are stacked with bungs up and examined frequently for loss or evaporation and absorption and refilled with a 40 grain vinegar. Unless watched carefully, the peppers out of the brine become soft, slimy and even moldy. They must be examined regularly until used up and must be kept filled with brine.

It will take from 6 to 8 weeks for the peppers to be cured so there are no white streaks when broken open. The original color of the green peppers changes to that more like an olive green. No peppers should be repacked in glass as long as they show white spots or streaks when broken open because a secondary fermentation may occur in the glass package resulting in loss of material, packages and sales as well.

When packed in glass the peppers are covered with a new 40 grain (4%) white distilled vinegar and allowed to stand overnight and rebrined before capping. Unless they stand and are rebrined a "head space" is present and the top peppers become soft and spoil. This space is often caused by a tight pack which does not permit the vinegar to penetrate the pack rapidly, consequently the necessity of adding more vinegar. As the peppers are hollow, it may take some time before the vinegar penetrates (if at all), because of the tough skin.

Peppers may be packed as straight varieties or mixed with combinations of other vegetables such as sliced sour or dill pickles, cut cauliflower, onion, carrots, etc., and by careful packing present a very neat package.

In order to present clean peppers which will not form a sediment upon standing, the barrels should be opened and the peppers rewashed in a rotary washer which will further remove loose seeds, leaves, stems, and any other extraneous matter which tends to cloud the package.

Old brine from the fermented peppers should not be used to fill the finished package unless it has been strained and filtered through a vinegar filter and is clear and brilliant. If possible, this vinegar should be heated to at least 190° or even to boiling before filtering, to destroy bacterial and yeast activity.

Should there be a tendency for the packages to become cloudy, heat the vinegar from 140-150° F., add it hot, and seal as soon as possible.

Some prefer peppers packed in sweet liquor and if so only peppers that have been thoroughly cured should be used. It is advisable to wash the cured peppers with water, then cover them with a 40 grain white distilled vinegar and allow them to stand for at least 4 to 5 days, and longer if time permits. Drain off the vinegar and cover with a sweet liquor containing 25 grain acidity and 35-40% sugar. Unless the peppers are washed, bacteria and wild yeast clinging to them may cause fermentation when placed in a sweet liquor. Some add hot sweet liquor, seal and then sterilize for about one-half hour at 150-160° F.

In packing peppers in glass the broken, misshapen, as well as off-color ones should not be packed but can be used in making a pepper relish when ground and mixed with the other vegetables that are usually used in making this product. These peppers should be soaked to remove the excessive salt and washed thoroughly before grinding or chopping. Drain well after chopping to remove excessive water, before using sugar, vinegar, spices, etc. As a straight relish is usually [illegible] pickles, onions, cauliflower and other vegetables

are mixed so that there is only about 25-30% peppers present in the mix.

SALTING PEPPERS:—Green peppers, burgherkins, wax beans, mango peppers, small red peppers, and melon mangos are all handled in about the same manner as cucumbers are salted. They are salted at the rate of 4¾ to 5 pounds of salt per 50 pounds of vegetables and 14 ounces of salt for each gallon of liquid used in covering. Gradually increase the salt to not less than 60° in order to keep. If desired the salt can be increased to 80°.

A certain class of people are very fond of sweet peppers packed in vinegar. The peppers may be fermented out in a salt brine the same as salt pickles and then handled the same as for sour pickles. Again they may be handled directly as follows:

Fill barrels with the peppers and add 6 to 7 pounds of salt while doing so. Add 1 pound of pickle alum either dissolved in vinegar or direct, and then fill the barrel with 50 to 55-grain vinegar. The dilute vinegar is used on the soft skin peppers such as finger and bullnose, whereas the 55-grain vinegar is used on the tough skin ones. After standing for several months, the peppers are repacked in kegs or glass and covered with a 40-grain vinegar.

RED PEPPERS:—Are usually blanched and cooked to remove the strong taste. Blanch the peppers in boiling water from 3 to 5 minutes or until the stem and seed pod are easily removed; they may then be cooked or steamed for about 10 to 15 minutes. Place in barrels and salt in the same manner as cucumbers, namely, 4¾ pounds of salt for each 50 pounds of peppers and 14 ounces of salt for each gallon of water used in covering. Gradually increase the salt 2° for five weeks, or until it tests 60°.

CHOPPED CABBAGE:—The white outer leaves from the trimmed cabbage used in making kraut can be used in making relish or chopped pickle. Do not use any other green leaves as they are not as fully matured and will not produce a good product. Chop the leaves fine and fill into barrels, salting at the same time, using 60 pounds of salt for each barrel packed. Increase the salt so that the brine tests 60°. It is not necessary to add water, as the salt will leach out enough liquid to make sufficient brine to cover.

CABBAGE CORES:—Place the cores in barrels and salt the same as chopped cabbage. The cores can also be used in making relish, but when the price of cabbage is low, the labor involved would hardly justify cutting out the cores, as a better product can be obtained by chopping the entire cabbage.

DILL HERB, OR WEED:—The herb used should be cut when the flower bud has just opened and before the seeds become ripe and fall off. The entire stock is used but should not be cut too close to the ground, as the stock end is usually hard and pithy with little or no flavor. It requires 75 pounds of green dill weed to fill a 50 gallon barrel and after brining with salt and vinegar it will weigh about 400 pounds.

Method A:—The weed can be packed in clean, open headed barrels by the addition of 60 pounds of salt, distributed while filling. Head up the barrel and fill with water.

Method B:—Instead of using just water, a 50 or 60 grain white vinegar, in addition to the salt, is used to leach out the flavor and thus produce a better product. This dill liquor is used in addition to the weed, in making dill pickles. Or again the dill weed is packed in a plain 50 grain vinegar without the addition of salt.

TARRAGON HERB:—Called Estragon, Dragonwort, or Tarragon is an herb similar to dill and should be handled in the same manner. Cut the herb when the flowers first open and before the seeds ripen and fall. Pack in barrels, the same as dill, adding 60 pounds of salt for each barrel and filling with water. If the herb is to be used in making Tarragon vinegar, it should be covered with a 50 grain white vinegar without the addition of salt and should be aged from 6 to 8 weeks.

SALTING WATERMELON RIND:—For fancy grocery trade there is nothing better than spiced watermelon and cantaloupe. Peel the melon, removing all green and red fleshy parts, and cut into cubes of about three-quarter inches square, pack in barrels and salt at the rate of 4¾ pounds of salt for every 50 pounds of melon and 14 ounces of salt for every gallon of liquid used. Increase the salt at the rate of 2° each week for five weeks and then 1° per week until it reaches 60°. Should a shorter method be desired, cover the cut melon with 80° salt brine and add 10 pounds of salt at the end of two days, allowing the rind to remain in this solution for about ten days and then transfer to a clean barrel, head it up and cover with a 60° brine. This should keep indefinitely without any fermentation.

SALTING CANTALOUPE OR MUSKMELON:—Only firm, ripe, spicy melons should be used. Peel and remove any soft fleshy part. Cantaloupes are softer than watermelon and in order to make them firm and crisp, alum salts may be used in the first salting. After cutting into ¾" cubes, place in barrels and cover with an 80° brine, in which 1¼ pounds of alum has been dissolved. At the end of 2 days, add 10 pounds of salt for each barrel, and at the end of an additional ten days, remove to clean barrels and cover with a 60° brine. The melon can then be used any time.

A rapid method in handling is to pour a warm dilute alum solution (1 ounce per gallon of water) over the melon and allow it to remain several hours and then to wash it in cold water. Cover with a 50 grain white vinegar and allow it to remain over night before finishing.

PROCESSING SOURS:—Pickles out of brine are emptied into processing tanks and covered with cold water, and soaked 12 hours or over night. Change the water in the morning and allow the pickles to soak until late in the afternoon, when the water is again changed and heated to about 130-150° F., allowing it to remain over night. If the stock is old, use 150°, but if new and firm, use 130° F. Before removing the pickles from the tank, flush or rinse them with fresh water to remove any yeast that might cause fermentation.

To crisp the pickles and make them firm, 1 pound of ammonium alum or soda alum per barrel of pickles may be used. Dissolve the alum in warm water and add it to the third soaking water, just before heating. Alum (alumen), according to the British and U. S. Pharmacopoeia, is potassium alum. It is added either to the third soaking water just before heating or else to the final sweet liquor that is added to the pickles. Salt will also aid in preserving and help to improve the flavor. Unless chemical tests were made, it would be impossible to tell when the pickles contained the desired 2-2½% salt. Therefore all the salt is removed and then more added so the pickles and brine will contain about 2%. The only objection to the addition of salt is that the pickles seem to bleach and turn white. When salt is added, the acidity can be increased as it will blend with the added salt to take away the intensely sour, harsh taste.

There is very little difference in the method of handling the salt stock with or without the use of alum salts. Some may give the pickles four soakings in cold water rather than two cold soakings and one hot before adding the calcium chloride, especially when they are to be used for bottling. Another method is to cover the stock with water and heat to 110° F. and allow it to stand 12 hours, drain and again cover with cold water and heat to 130°, and again allow it to stand for 12 hours; cover a third time with fresh water and reheat to 140°, then add 3 pounds of salt for every barrel of salt stock in the tank. After remaining in the water for about 12 hours, the pickles are ready for the final process before glass packing.

Another method used by some is to dump the salt stock into the tank, cover with water and heat to 112° F., stirring every 10 minutes to permit faster leaching of the salt and prevent overheating of the pickles on the bottom and near the steam pipes. The proper amount of alum (1 pound for

each barrel of salt stock) and turmeric (2 ounces for each barrel) is scattered over the pickles when processing is started. The pickles are allowed to stand overnight in this water. To aid in quicker and more uniform extraction of the salt, a steam siphon or a pump is attached to the tank and the water is kept in constant circulation by drawing it from the bottom and emptying it on top of them. With a steam siphon there is the danger of the water becoming too hot and "cooking" the pickles unless a special regulator is used or constant watch kept over the temperature. The next morning the processing water is emptied and the pickles flushed with fresh water from a one-inch water line until they are clean. This removes dirt, debris, wild yeast and bacteria. Again cover the pickles with fresh cold water and they are ready for sorting.

For sours the processed pickles are covered with a 65 grain white vinegar and allowed to stand for about 5 days before shipping. The addition of some spices to sour pickles improves the flavor. Some use a 45 grain vinegar to cover the pickles.

Should the pickles become very pale and white near the blossom end, turmeric at the rate of two ounces per barrel of salt stock is added to the second process water just before heating. The turmeric will give the cucumbers a slight yellowish appearance. The salt stock may be sorted, either before or after processing. As the pickles usually require sorting after processing to remove broken ones, a prelminary sorting seems a needless expense. After processing, the pickles can be sorted for size directly into barrels or kegs. When thus handled, the packages should be well drained by having a ¾" hole in the bottom, to prevent the reduction of the vinegar.

SWEET PICKLES:—The same processing steps are taken in handling salt stock for sweets as for sours. Some do not heat the water during the processing, but give the pickles an extra soaking in cold water, especially if they are to be glass packed. The temperature of the water used, room and atmospheric temperature will to a certain extent influence the time and manner of soaking. In extremely cold weather, the water used should be slightly warm. Alum salts are added at the rate of one pound per barrel for bulk sweet pickles, or calcium chloride at the rate of one pound per barrel, for bottled goods.

CAULIFLOWER:—Cover the salt stock with cold water in the morning and heat to 90° F. If heated much higher, the cauliflower will break apart and the blooms come off. Late in the afternoon, change the water and again heat and allow the tank to stand over night and in the morning drain well. To make the product more firm and crisp, add 1 pound of alum per barrel to either the first or second water. The cauliflower is then ready to be trimmed for either sweet or sour process. Instead of alum, calcium chloride at the rate of one pound per barrel of cauliflower, or else 5 pounds of salt per barrel can be added to the last soaking water.

Cauliflower has a tendency to become yellow or dark in handling, and in order to whiten it, sodium sulfite solution is added at the rate of 1 ounce per 12½ gallons of water used in the final processing. The trimmed cores and broken pieces of cauliflower are used in making relish.

ONIONS:—Cover the salted onions with fresh water, to which has been added 1 pound of alum for each 50 gallons and heat to 90° F., allowing them to stand all day. Add fresh water and again heat to 90° and allow them to soak over night; drain and use either for sours or sweets. Before soaking, if the brown outer skin, stem and rootlets have not been removed before salting, they should be trimmed. After processing any loose or trimmed white skins may be placed in 45 grain vinegar and later used for relish. It is not advisable to hold the onions in cold water more than two days and the water should be changed occasionally to keep fresh [illegible] better to cover them with a 50 grain vinegar if they are to be held any length of time. Soaking in hot water will fatten up the onions and also remove the strong taste. Calcium chloride may be substituted for alum salts but only one-half as much should be used. Salt at the rate of 5 to 6 pounds per barrel can be substituted for these. In processing onions, the temperature at which the water is heated should never exceed 90° F., as the layers may break apart or become loosened. To whiten they are also bleached with sodium sulfite, at the rate of 1 once for each 12½ gallons of water used in the final processing.

GREEN TOMATOES AND GREEN MANGO PEPPERS:—These are processed the same as cucumbers and are used in relish, piccalilli, etc.

WAX BEANS:—Leach in cold water for 12 hours and heat the second fresh water to 120° F., giving 12 hours for such soaking. Beans after processing should not be allowed to remain uncovered or in plain water as decomposition is likely to set in. If the beans can not be used at once, they should be covered with 50 grain vinegar. To crisp and prevent falling apart, alum at the rate of 1 pound per barrel should be added to the first soaking water.

MANGO PEPPERS:—These are processed in cold water only, so they will not fall apart. Soak in cold water for 12 hours, and again soak in fresh water to which 1 pound of alum has been added per barrel for 12 hours. Drain and cover with a 45 to 50 grain vinegar.

BURGHERKINS AND MANGO MELONS:—Soak for 12 hours in cold water, cover with fresh water, and add 1 pound of alum per barrel, and again soak 12 hours; again change the water, and heat to 110-120° F., and allow them to stand for 12 hours. They should then be covered with a 50 grain white vinegar until ready to be used.

WATERMELON RIND:—Soak the rind in fresh water about 8 to 10 hours; drain and cover with fresh water, adding 1½ pounds of alum for each barrel of rind, and soak again for 12 hours. Change the water and heat to about 90° F. and soak again for 12 hours. Drain off the water and cover with a 50 grain white vinegar.

CANTALOUPE:—Proceed to extract the salt by the same process as is used in watermelon rind, but only add one-half pound of alum to the process water, if they are not crisp, as alum was used when they were salted. After processing cover with a 50 grain white vinegar until ready for use.

SPICED SWEET LIQUOR:—

170 gallons, 100 grain white vinegar.
4700 pounds granulated sugar.
15 ounces oil of cloves.
7½ ounces oil of cassia.
8 ounces oil of pimento.
Water sufficient to make 750 gallons.

Make according to the above directions. This should make a spiced liquor of about 60% sugar and 2.25% acidity.

This spiced sweet liquor can be made by heating or some make it cold by mixing the vinegar, water and oils together in a mixing tank, then adding the sugar and continuing agitation for one hour. The spiced liquor is then ready for use.

Cheap sweet liquors can be made according to the following:

A	B
30 gallons, 58 grain white vinegar	32 gallons, 40 grain sugar vinegar
12 gallons of water	10 gallons, 40 grain white vinegar
100 pounds of sugar	100 pounds of sugar
½ ounce oil of cassia	½ ounce oil of cassia
1 ounce oil of cloves	1 ounce oil of cloves
Produces 68 gallons	Produces 68 gallons

Cucumbers are sorted according to size by this machine. Fingers in the openings move them, small ones dropping out first.

A better product, and of course a more expensive one, can be made by substituting malt vinegar in whole or part for the white vinegar. These liquors will test 28% and 3.3% acid; and as syrups of these strengths will hardly preserve pickles, the use of benzoate of soda is necessary. It requires 7⅛ ounces of benzoate per 48 gallons of the above syrup.

Another Method:—Slowly cook the whole spice in bags in the vinegar, sugar, and water for several hours. Allow the spice to remain in the solution, preferably while cooling, and over night if possible. The following formulas can be used to produce a very good sweet spiced liquor:

	Formula A	Formula B
Granulated sugar	3916 lbs.	4700 lbs.
100 grain vinegar	215 gals.	170 gals.
Whole cloves	11¼ lbs.	10 lbs.
Coriander seed	13⅛ lbs.	
Yellow mustard seed	16⅞ lbs.	
Cardamon seed	1¼ lbs.	
Celery seed	1⅛ lbs.	
Ginger root	3¾ lbs.	8½ lbs.
Caraway seed	¾ lbs.	
Allspice—whole		56 lbs.
Cassia—broken		35 lbs.
Mace		5¼ lbs.
Japan chillies		5¼ lbs.
Water to make	750 gals.	750 gals.
Tests:—Sugar	50° Brix	60° Brix
Acidity	2.8%	2.25%

After the syrup has cooled, remove the bag and filter to obtain a bright product.

Another means to leach out the flavor from the spices is by passing 100 grain vinegar through them. To this add sugar and water, and cook until the sugar is dissolved. Use spices according to either formula A or B, and place in bags in a tank or barrel that can be covered; then cover with hot 100 grain vinegar and allow this to stand overnight. Draw off the spiced vinegar and again cover with hot vinegar. Allow this extract to stand all day, then draw off. Cover a third time with hot vinegar and allow this to stand overnight. Drain thoroughly and should there be any vinegar left from the amount necessary in making the liquor, slowly add it to the spice and then follow it through with the water that is to be used for the batch. Take the accumulated spiced vinegar, adding the proper amount of sugar, and heat slowly until dissolved, then filter. If the vinegar can be circulated by pumping, a much quicker and better extraction can be accomplished.

Instead of filtering the syrup, the sugar may be placed in a tank that has a strainer bottom similar to a sugar percolator, and the spiced vinegar poured over it; this liquor working through the sugar dissolves and filters it, producing a clear product.

The per cent of sugar may be determined by using either a Brix or Balling sugar hydrometer, both giving the same readings. The acidity should be tested with a vinegar burette.

The 100 grain white distilled vinegar used should be free from any odor other than vinegar, almost water white, with a low metallic content, especially in copper and iron.

ONIONS, CAULIFLOWER, ETC.:—In finishing such products as onions, cauliflower, mango melons, cantaloupe, watermelon, etc., after the salt had been leached out, they are placed in 50 grain vinegar for about 5 days, after which they are covered with an unspiced sweet liquor containing 50% sugar and 5% acidity. After remaining in this liquor for about 5 to 7 days, they are covered with a spiced sweet liquor containing 60% sugar and 2.25% acidity. After remaining in this liquor for about one week, they are ready for shipping.

SOUR PICKLES:—Sour pickles are very seldom spiced, although a little spicing produces a better product. Mixed spices may be added to the kegs or barrels, when filling. The following are good spice blends for sours:

Whole cloves 4 pounds
Allspice 15 pounds
Yellow mustard seed 20 pounds
Black pepper 2 pounds
Chili peppers 3 pounds
Bay leaves 2 pounds

MIXED PICKLING SPICE

Allspice	40 lbs.
Coriander seed	30 ibs.
Cloves—Zanzibar	20 lbs.
Broken Jamaica ginger	20 lbs.
Broken bay leaves	6 lbs.
E. D. Long peppers	5 lbs.
Mace—Penang	2 lbs.
Cardamon seed	2 lbs.
Yellow Mustard seed	20 lbs.
Black pepper No. 2	10 lbs.
Cassia No. 2 Broken Batavia	16 lbs.
Jap. Chillies No. 1	10 lbs.

Use about 1 pound per barrel, 10 ounces per 30 gallons and 6 ounces per 15 gallon keg of pickles. Should a spiced liquor be desired, take 10 pounds of the above blend of spices and add them to 100 gallons of 50 grain vinegar and allow this to stand for about 10 days to leach out the flavor. Use this vinegar to cover the pickles. Care should be taken to keep the acidity above 2.25% when they are shipped. About 2% salt (8-10 lbs. per barrel) in the finished pickle helps to give the sour pickles a better flavor, so that they will not taste too sour.

KRISPY KROSS KUT PICKLES:—These sweet sliced cross cut pickles are very appetizing if properly made. It will take 15 barrels of large whole pickles to produce 10 barrels of slices. For rapidity and economy in slicing, a machine is used to cut the pickles in cross pieces about ¼ to ⅜ inch thick. It cuts uniform slices quicker and far better than hand slicing. If the following procedure is observed, a high grade, crisp pickle will result.

Process 15 barrels of large salt stock pickles by heating in water at 150° F. and allow them to stand 24 hours. Change the water and again heat and add alum at the rate of 1½ pounds per barrel, i.e., for 15 barrels it requires 22½ pounds. Allow them to stand again 24 hours. Change the water again and allow them to stand in cold water until ready for use. Then slice, and place them again in cold water to hold, using 4 ounces of alum for each barrel of cut pickles. They are usually kept in this water 24 hours, then drained thoroughly

and treated with a sweet liquor. Place in barrels or a tank and cover with a hot sweet liquor made as follows:

2 barrels of 40 gallons each white distilled 100 grain vinegar.....	80 gallons
Granulated sugar	400 pounds
Whole allspice	4 pounds
Celery seed—whole	3 pounds
Mustard seed—whole	3 pounds

Cook together for 15 minutes.

Add this spiced sweet vinegar to the 10 barrels of slices in a tank and add the following sugar:

1st day — scatter	100 pounds over the slices
2nd day A.M. — scatter	200 pounds over the slices
2nd day P.M. — scatter	200 pounds over the slices
3rd day A.M. — scatter	200 pounds over the slices
3rd day P.M. — scatter	150 pounds over the slices

This is at the total rate of 125 pounds for each barrel of sliced pickles. The following spice oils are also used for the 10 barrels of slices:

Oil of cloves	10 ounces
Oil of cassia	5 ounces
Oil of pimento	5 ounces

The second day the oil is added to the sugar before it is scattered over the pickles.

PEELED SPICED PICKLES:—One way of utilizing the very large pickles is to peel them and remove the salt, crisp by using alum, and then cut into thin slices the full length of the pickle. They can be soaked in 65 grain vinegar for 4 or 5 days, then placed in sweet liquor of 50° Brix for about one week and covered with a 60° spice liquor. This makes a very excellent pickle similar to spiced cantaloupe or watermelon.

PEELING PICKLES:—Hand peeling is usually very expensive, but they can be peeled by lye treatment. Heat a 10% solution of lye or caustic soda to 170°, and immerse the pickles for 4 minutes, then spray immediately or pass through a rotary tomato washer, spraying as they pass through. Possibly the time can be reduced, depending upon the skin of the pickle. It might be well to take out a few at the expiration of one, two, and three minutes, and try them to see which time gives the best results. This process removes the skin.

The operator using the lye must be careful not to get it on his hands, or he may have very sore hands as a result. It would be well to wash the hands with a 100 grain vinegar to neutralize the caustic, and then rinse in fresh water. After removing the excessive caustic, immerse the pickles in 50 grain priming vinegar to neutralize any caustic that may have penetrated.

MUSTARD PICKLES:—Place the fresh green cucumbers in a salt and vinegar solution. This is a very slow process that cures them but makes a crisp tart pickle. To a barrel of about 8000 size cucumbers, add a mustard vinegar to cover. To make this vinegar dissolve, 6 pounds of mustard, 15 pounds of salt and 12 pounds of brown sugar in 45 grain cider vinegar. This method reqires about three months.

BREAD AND BUTTER PICKLES, OR, OLD FASHIONED CUCUMBER PICKLES:—There are a number of ways that this style can be made.

Method No. 1:—Large cucumbers about 1 inch to 1½ inches in diameter are used in making this style pickle. They are chipped into slices or discs about ¼ to ⅜ inch thick. If cut much thinner they break apart and are not as firm as [illegible]. The discs are then placed in barrels or tanks and covered with a 25 grain vinegar containing a mixture of [illegible] pounds of salt, 4 to 6 ounces of turmeric, and 4 ounces of [illegible] gas issued, after which they are allowed to stand about [illegible]. The liquor covering these slices is [illegible] sweet spiced liquor used in finishing them, because it has all of the natural cucumber flavor. This liquor should be boiled for about 5 to 10 minutes in order to pasteurize and prevent later spoilage. A spiced sweet liquor can be made by adding more 100 grain vinegar, 5 pounds of sugar, 4 ounces mustard seed, and 2 ounces celery seed per gallon of brine made. The cut pickles are placed in jars and hot spiced liquor added, capped and sterilized for 20 minutes after the temperature reaches 160° F.

Method No. 2:—Another method is to cut the cucumbers into chips and soak overnight in a 30° brine, which has been heated to 125° F. and to which 4 ounces of turmeric have been added. A sweet liquor is made with 50 grain vinegar, 5 pounds of sugar, small amount of turmeric (about 1 ounce), 4 ounces mustard seed, and 2 ounces celery seed per gallon. Heat to make this liquor and add hot to the pickles. A little better result is obtained by cooking the cut pickles in the liquor for a few minutes, but care must be observed or they will become too soft.

Others soak the thick slices in 30° brine overnight, and then cook slowly in a 25 grain vinegar until tender; glass-pack and cover with a hot sweet liquor:

23° Brix—sugar
24 grain vinegar

Cap hot and sterilize 15 minutes at 160° F. These are more likely to be soft due to the high temperature.

Method No. 3:—Fresh cucumbers are sliced crosswise about ⅛" thick. The slices are then placed in a 30° salt brine, containing 1 pound alum per barrel, overnight. Turmeric is added to give the cucumbers the desired golden color. The next morning, after heating to 110° F., drain the slices, pack in jars and to each 10 ounces of slices add about 6 ounces of hot sweet vinegar prepared as follows:

To each gallon of 70 grain white distilled vinegar add—
4 pounds cane sugar
1 ounce mustard seed
2 ounces celery seed
2 ounces black pepper (ground)

Simmer in a covered vessel at 125-150° F. for several hours, and bring to a boil when ready for use. Instead of cooking the spices in the vinegar, about a teaspoonful of dry spices may be added to each jar. The final product should have a pronounced celery flavor, and it is recommended that the sweet vinegar be well spiced. Seal under vacuum, as no sterilization is required. Do not use screw caps, because the product will darken to such a degree as to be unsaleable.

GREENING PICKLES:—There is a demand for green pickles by some of the trade as there is a belief that green pickles are fresher and better flavored than the dark olive or brown colored pickles. Pickles can be "greened" two ways.

1. By the addition of copper sulfate.
2. By using green coal tar dye.

If they are colored with copper sulfate use 2 to 3 ounces for each barrel of pickles in the first vinegar that is used to cover them, or by dissolving the copper sulfate in the second process water and heating to set the color.

They may be colored by using the mixture of green color as outlined under mint jelly. The addition of this coal tar dye should be declared on the label and in some states may be illegal.

SACCHARIN PICKLES:—There is a demand for such pickles by persons who cannot eat foods containing sugar, due to diabetes, and by those who wish to keep down their weight by reducing sugar intake. Many states do not permit the use of saccharin, while some do, if its presence is plainly and conspicuously declared. Be sure and make the proper investigation before placing these on the market.

Only sound, properly matured, cucumbers should be used. Be sure to wash them thoroughly before packing. [illegible]

drained pickles into barrels and cover with a liquor made of the following:

White distilled or cider vinegar.....	25 gallons
Saccharin	2¼ ounces
Sugar—granulated	15 pounds
Salt	15 pounds
Powdered Mustard	4¾ pounds

They should stand for from 4 to 6 weeks until they have obtained their maximum flavor.

GENUINE DILL PICKLES are made with cucumbers, dill weed, spices, salt (or dilute salt brine) and vinegar and are then handled in such a manner as to encourage a lactic fermentation.

As the manufacturing of genuine dills is a seasonal problem, it is often quite difficult for any manufacturer to forecast his needs and accordingly pack the amount needed for his future orders. He may take the amount he has packed in the past and therefrom strike an average which will be his basis for packing. He may endeavor to pack his required amount for orders and future business, but climatic conditions may control the growth and development to such an extent that there may be quite a scarcity of pickles, so that in order to fill all orders, he feels that he must make imitation dills, and believes that he is at liberty to sell them as genuine without informing the trade as to the difference. His business may develop to such an extent that his season pack is exhausted early in the fall of that pack, leaving him with none to fill his winter and spring orders. Of course he may go out on the open market and buy genuine dills to replenish his stock but would prefer having his own stock for several reasons; first, his customers may have been educated to the flavor of the pickle he packs and, second, he can usually make more money on his own pack as he does not have to pay the middleman's commission or profit to the original packer.

Again nature may step in and destroy the supply of pickles by drought, insects and bacterial contamination to such an extent that the percentage of yield is far below his needs and he is compelled to buy additional raw products. It is these manufacturing differences that have at times hurt the sale of genuine dills. Often an inferior flavored pickle is packed and sold and its sale does not help to improve the trade in this commodity. There is often quite a difference in the flavor of dill pickles. While some have a crisp, delicious, appetizing, slightly sour dill flavor, others are soft, with no acid taste and a very poor dill flavor. A genuine dill pickle is a credit to any manufacturer but a poor dill is no credit but rather a handicap.

The packing season for dills is often of so short a duration that vast quantities must of necessity be handled within a short time, requiring almost day and night barreling in order to obtain the quantity necessary for orders. The quantity of pickles coming into a salting station may be so great as to swamp the pickle station to such an extent that it is compelled to put the pickles down in heavy salt brine. Time is often an important factor and as genuine dills, even when packed in tanks, require more time to handle, necessity may compel the surplus to be handled for salt stock. For many reasons dills are packed in barrels. Early and late in the season the pickle receipts may be so small that they could not be handled otherwise without great losses. Due to the rapid spoilage of dills, they must have the air excluded as much as possible and certainly need constant attention when processed in tanks to see that the scum is removed and the pickles kept under the brine, thus preventing decomposition. So far the packing of dills in tanks in large quantities has not been a commercial success.

QUALITY OF RAW PRODUCTS:—To pack quality dills, cucumbers that are firm, sound, free from blemishes, spot rot, wilt, sack spot, insect bites, etc., must be used. The cucumbers are usually delivered to the stations in slatted boxes and baskets. They are then sorted and the proper size for dills is removed and the other vat run pickles are salted heavily for regular salt stock.

PREPARATION:—After sorting out the proper size pickles for dills, they are placed in barrels that have been thoroughly cleaned or steamed. Barrels that are used for packing other foods can be used. Of course, barrels that have been used for oil or fish cannot be used. It was the practice of many of the old packers to use whisky barrels after scraping out the charcoal. Barrels that have been used for vinegar can be used as the vinegar is not objectionable because the acetic acid checks the development of foreign bacteria.

Drain the dill weed that has been packed and place about three pounds in the bottom of the barrel. Then fill it about one-half full of cucumbers and add one pint of mixed dill spice, eight pounds of salt, then three pounds more of the drained dill weed, fill the barrel to near the top with pickles, shake well and add the balance of the weed, dill vinegar and the balance of the spice; head up the barrel and fill with water, bung and roll out of the way, with the bung up.

The filled barrels are usually allowed to stand until the next day to allow the salt to dissolve and mix uniformly before they are stacked. Barrels should be covered to keep off the heat from the direct rays of the sun, especially if the barrels are stacked in the open rather than under the tank platforms in the salting station. A temperature of 85° F. is the one most favorable for the development of the lactic fermentation and to cure the pickles to best advantage for eventual quick sale.

Instead of using 16 pounds of salt per barrel of pickles they may be covered with a 20-22° salt brine after heading them but some prefer a 28-30° brine as the pickles will keep better. The finished dills should test about 20-22° salt with acidity of 0.750% to keep properly.

The following is the completed formula for barrel of genuine dills:

Drained dill weed aged in vinegar and salt	8 pounds
Dill vinegar from above weed.....	3 quarts
Dill spices—mixed	3 pints
Salt	16 pounds
Pickles to fill barrel, fill with potable water to capacity of barrel.	

To produce a "hot" dill for Southern trade, add a few ounces of small dried red pepper corns (cayenne peppers) to each barrel.

Some add plain vinegar instead of dill vinegar but the dill vinegar is preferable because it contains the dill flavor from the weed, it helps retard the growth and development of undesirable organisms and will assist in the development of the lactic bacteria.

By bunging the barrels, the air is excluded and foreign bacteria are prevented from entering and a very active lactic fermentation quickly starts with very little if any yeast fermentation. Some prefer leaving out the bungs during the period of fermentation so the gas formed can pass off and, at the same time, they can watch the activity of the barrels and when fermentation ceases, fill up with brine of the same strength. During fermentation, brine is often forced from the barrels and they must be kept filled and the pickles kept beneath the liquor as the pickles spoil quickly when exposed to the air. It is better to put bungs in the barrels as in most cases the gas is kept in and helps to keep the pickles crisp, impart added tartness besides keeping out objectionable bacteria and give a better flavor. The pressure of gas formed is often so great as to burst the barrels or force out the bung. This fermentation is usually terminated in about three or four weeks, of course depending upon weather conditions but the pickle has not been properly cured until a few weeks later and will require a total time of about 6 to 8 weeks for the pickle to develop and mature to

its full dill flavor. The sourness, in addition to the vinegar added, is due to the lactic acid developed during the fermentation. They are fully fermented if the cell structure shows no white streaks when broken open. If they show any whiteness they should not be used until it disappears, at which time they will have the fine dill flavor and crispness that makes them so good.

As mentioned before, it is not advisable to pack dills in tanks due to the great care necessary in handling and especially with the great losses if spoilage should occur.

STORAGE OF DILLS:—Many store the barrels of dills in the open without being covered, while others use the space beneath the floor of the salting station and between the tanks. Barrels should be stored in a shed or under cover where they do not get the direct heat of the sun. In the sun, the fermentation is often too rapid, and salt absorption may be so rapid as to cause collapse, or even softening of the pickle.

If the barrels of dill pickles are stored in the open in the sun without any covers or boards on them there will be about 10% loss due to soft, spoiled dills, whereas if they are kept covered and away from the direct rays of the sun then no spoilage should occur.

Dill pickles can be cured in open tanks, but great care must be observed in handling them after active fermentation ceases, otherwise spoilage will develop. Yeast will develop on the surface and must be removed to prevent decomposition and at all times the cucumbers should be kept under the brine. They should be removed from the tanks and packed in barrels as soon as possible. Salting in tanks has many disadvantages, and small tanks only large enough to hold the day's pack should be used. During the great rush in handling pickles, it may be advisable to pack in tanks; the scarcity of labor, or the shortage of barrels may necessitate their use. See that the brine is always at 22° and should it fall below, add salt to bring it up to this point. Some prefer to use a 30° brine.

As the natural acid present in dill pickles is lactic, this acid may be used instead of the 100-grain vinegar. As there is present about 0.5-0.75% lactic acid, to produce an acidity of this amount in the finished pickles, it will require an acidity of at least 2.0% in the brine that is to be added.

Five barrels of salt stock, 2,400 size, should produce six barrels of finished dills. Each barrel will require about 18 gallons of a 22° brine to cover the pickles, 2 pounds of alum in processing, and 20 pounds of dill weed.

DILLS IN RETAIL PACKAGES:—When first packed for the retail trade (other than bulk in barrels), dills were sold in cans. It was customary to paraffine the cans carefully, pack the dills therein and cover with the dill brine, seal, wash the cans and label. The lids were painted with hot paraffine and cooled before being used. All paraffine was tested to see that it is free from kerosene or carbon oil.

On account of the acidity and salt, plain and lacquered cans would often perforate or pinhole quickly. Even with lacquered cans, there are always slight imperfections in the lacquer that are not visible to the eye but which can be clearly demonstrated by the use of the gelatin, acid, ferrocyanide mixture applied to the cans and dried.

Now manufacturers are packing in glass and must take greater care in handling their product so the package will appear perfect. When genuine dills are packed in glass, instead of covering them with the original dill brine which is very "milky" a new brine is made by dissolving sufficient salt and vinegar so that it will have a 22° salt and a 1% acidity.

GARLIC DILL PICKLES:—This flavored dill pickle can [illegible] made by adding 2 pounds of ground garlic buds for each [illegible] dill pickles. This may produce too strong a garlic [illegible] would suggest making an experimental pack, [illegible] pound, 1 pound, 1½ pounds and the 2 pounds suggested and then selecting the one flavored properly for one's [illegible] pounds of ground garlic per barrel of pickles with success as the 2 pounds is rather strong for some.

CARAWAY DILL PICKLES:—Again this flavored dill pickle is demanded by a particular class of people and can be produced by using caraway seed or if near the source of supply, the herb can be used the same as dill herb and even packed in barrels the same as dill herb.

Use 1¾ pounds of the caraway seed per barrel. Throw the seeds into boiling water and cook for 3 to 5 minutes until they begin to swell and then add them to the barrels when the dills are being packed. Again the amount of seed may have to be varied. Start the pack first using ½-1-1½-1¾ pounds of seed for each barrel.

SWEET DILL PICKLES:—Take the genuine dills that are completely fermented, wash to remove yeast and bacteria. Cut into discs about ¼ to⅜-inch thick and cover with a sweet liquor containing 60% sugar and 5.0% vinegar. A stronger flavored sweet dill can be made by using a portion of the dill liquor, adding the necessary sugar and vinegar. This liquor should be boiled to destroy the activity of yeast and bacteria.

The following formula produced a very good sliced sweet dill pickle:

White distilled vinegar—100-grain	10 gallons
Mixed spices	1 pound
Allspice	3 pounds
Clove	½ pound
Celery seed	1 pound
Dill emulsion, 10% oil	2 ounces
Alum or calcium chloride	½ pound
Sugar	80 pounds

Will cover 1 barrel of finished pickles

Process, or imitation, dills can be used instead of the genuine, as they will be firmer and not so likely to break down and become soft. Make a concentrated dill brine and add the necessary sugar and vinegar to produce a sweet liquor and cover the cut pickles.

DILL SPICES:—Blend together the following whole spice:

	A	B	C
Black pepper	12 pounds	4 pounds	4 ounces
Cloves	12 pounds	6 pounds	4 ounces
Cinnamon	8 pounds	6 pounds	—
Allspice	—	6 pounds	1 pound
Coriander	—	6 pounds	—
Bay leaves	—	1 pound	4 ounces
Yellow mustard seed—whole	—	—	4 ounces
Celery seed—whole	—	—	2 ounces
Ginger root—broken	—	—	2 ounces

From visual inspection, especially in the finished package, it is often quite difficult if not impossible to differentiate between genuine and imitation dill pickles. It may only be by tasting that the difference can be detected, and in some cases there might even be a question of doubt.

Too, some packers of genuine dills make a new artificial brine to cover the pickles rather than take the time and trouble to filter the old brine in order to produce a clear, sparkling liquor. A good filter, such as is used for vinegar filteration, can be used, but it must be of non-corrosive material, as both the salt and acid cause rapid deterioration and destruction of the filter. The coarse particles should be removed from the brine by straining, preferably through cloth strainer.

IMITATION DILLS, PROCESS DILLS, OR SUMMER DILLS are those made by taking salt stock that has been completely fermented by undergoing the lactic fermentation [illegible] by a strong salt brine, leaching out the salt and treating with

"pickle alum," adding dill weed, dill brine, dill emulsion, vinegar, salt and spices.

If made properly, this pickle is very delicious, but there are many of such poor quality that they hurt the sale of all dill pickles. To make this pickle, completely fermented salt stock should be used. After sorting for size, the product should be placed in a tank, covered with water and should stand for 12 hours or overnight.

Then cover again with fresh water and soak until late in the afternoon, when the water is again changed and the fresh water is heated to 130° F. and allowed to stand overnight. To this last water, pickle alum is added at the rate of 1 pound per barrel of salt stock. Dissolve the alum in warm water and add it to the pickles, and see that it is mixed. The alum will make the pickles hard, and crisp them so they will "snap" when broken. If there has been no spoilage in the salt stock used, it is most unlikely that any will occur after this treatment as the cells and tissue have been hardened and bacteria cannot then break them down. Make a brine for covering the processed pickles so as to contain 30-grain acidity and 22° salt. Nine ounces of salt per gallon will make a 22° brine. In making this brine, add 4 to 5 gallons of genuine dill brine for each 150 gallons and 20 ounces of a 10% dill emulsion. The more old dill brine used the better the flavor imparted.

Place about 3 pounds of dill weed (packed in salt and vinegar) in the bottom of each barrel. Fill half full with the processed pickles and again add about the same amount of dill weed. Fill the barrel with pickles, sprinkle about 12 to 16 ounces of dill spice on top, then place some more dill weed on top, head up the barrel, and fill with the above dill vinegar, bung and stack. The barrels should stand for at least one week to age properly, and even longer is much better.

Instead of the dill vinegar brine, the following can be used:

1 barrel of dill weed packed in salt and vinegar
25 gallons of 100-grain white distilled vinegar
350 gallons of potable water
187 pounds of salt

Cook all together for a short time and allow to stand for several hours or even overnight, in order to leach out the dill flavor. This should produce 400 gallons of a 22° brine. Proceed the same as above by packing the pickles in barrels and using about 8 to 10 pounds of fresh dill weed and 1 pound of spice to each barrel of pickles. As the acidity of genuine dill pickles is from 0.75-1.50%, then these imitation ones should have an acidity close to that.

DILL EMULSION:—Dill flavor is obtained by adding a dill extract made either with "grain" ethyl alcohol or some other menstruum, or by using a dill emulsion, or by using dill weed.

This emulison can be made by using gums, genuine oil of dill and water. It may be made in a mayonnaise beater, in which all the parts are made of metal. This makes cleaning easier.

10 PER CENT DILL EMULSION

Dill oil	1 quart
Powdered gum arabic	5 ounces
Powdered gum tragacanth	5 ounces
Water to make (2¼ gallons)	2½ gallons

Use this method in making the emulsion: Pour the oil into the mixing bowl and add the gums. Then mix to prevent lumping, and break apart as it permits each particle of gum to be coated with oil and makes a more stable emulsion. Next, start the stirrer at medium speed and slowly add 1 gallon of hot water and follow with the balance of the water, which can be either hot or cold, preferably warm in cold weather. The use of about 1 to 2 ounces gives the desired flavor for each 200 gallons of brine. When a mayonnaise mixer with a separate oil tank is used, the water can be run in from the reservoir.

Styles of Cucumber Pickles

Whole or **Whole Pickles** means cucumber pickles consisting of whole cucumbers.

Cross Cut, Slices or **Sliced** means cucumber pickles consisting of units irrespective of whether such units are cut at right angles to the longitudinal axis into units of approximately equal thickness or cut longitudinally into halves, quarters, eighths or into units with parallel surfaces.

Cut or **Cut Pickles** means cucumber pickles which are not uniform in size or shape or which do not conform to any of the foregoing styles.

Finely Cut or Finely Chopped Pickles means cucumber pickles which have been finely cut or finely chopped.

Unit means an individual cucumber pickle or pickle ingredient or portion of either in cucumber pickles.

Types of Cucumber Pickles

Dills or **Dill Pickles** are of two classifications:

Genuine dills or genuine dill pickles consist of cucumber pickles prepared from fresh immature cucumbers cured by natural fermentation in a solution of common salt with dill herbs with or without dill flavoring in a liquid packing medium, with or without additional spices, spice flavorings, or other seasonings or flavoring ingredients. Dill herb and other herbs may be added. The packing medium contains not less than 0.6 gram of acid (calculated as lactic) per 100 milliliters.

Processed dills or processed dill pickles consist of cucumber pickles prepared from fresh immature cucumbers cured by natural fermentation in a solution of common salt in a liquid packing medium containing dill flavored brine, a vinegar or vinegars, spices, spice flavoring, or other seasoning or flavoring ingredients. Dill herb and other herbs may be added. The packing medium contains not less than 0.6 gram of acid (calculated as acetic) per 100 milliliters.

Sour Pickles consist of sour cucumber pickles in a liquid packing medium to which has been added salt, a vinegar or vinegars, with or without the addition of spices, spice flavoring, or other seasoning or flavoring ingredients. The packing medium contains not less than 1.4 grams acid (calculated as acetic) per 100 milliliters nor more than 2.4 grams acid (calculated as acetic) per 100 milliliters.

Salt is being poured into this vat and water will be added to make brine. Dry salting is less reliable and now antiquated.

Sweet Pickles consist of sweet cucumber pickles in a liquid packing medium to which has been added sugar or a combination of sugar and dextrose (refined corn sugar), or a combination of sugar and corn syrup or corn syrup solids, or a combination of sugar, dextrose, and corn syrup or corn syrup solids, salt, a vinegar or vinegars, with or without the addition of spices, spice flavoring, or other seasoning or flavoring ingredients. The packing medium contains not more than 3.0% salt.

Mixed Pickles consist of mixed cucumber pickles which may be of any of the foregoing styles (except finely cut or finely chopped cucumber pickles) to which has been added onions and cut cauliflower with or without the addition of red peppers, pimientos, or pieces of red peppers or pimientos in a liquid packing medium with or without the addition of sugar or a combination of sugar and dextrose (refined corn sugar), or a combination of sugar and corn syrup or corn syrup solids, or a combination of sugar, dextrose, and corn syrup or corn syrup solids, salt, a vinegar or vinegars, with or without the addition of spices, spice flavoring, and other seasoning or flavoring ingredients. Mixed pickles may contain ingredients in the following proportions:

	By weight Percent
Cucumbers	60-80
Cauliflower	10-30
Onions	5-10
	Optional
Red peppers or pimentoes	Ingredient

Mixed pickles are of two classifications:

Sour mixed pickles consist of mixed cucumber pickles in a liquid packing medium to which has been added salt, a vinegar or vinegars, with or without the addition of spices, spice flavoring, or other seasoning or flavoring, or other seasoning or flavoring ingredients. The packing medium contains not less than 1.4 grams acid (calculated as acetic) per 100 milliliters or more than 2.4 grams acid (calculated as acetic) per 100 milliliters.

Sweet mixed pickles consist of mixed cucumber pickles in a liquid packing medium to which has been added salt, a vinegar or vinegars, sugar or a combination of sugar and dextrose (refined corn sugar) or a combination of sugar and corn syrup or corn syrup solids, or a combination of sugar, dextrose, and corn syrup or corn syrup solids with or without the addition of spices, spice flavoring, and other seasoning or flavoring ingredients. The packing medium may contain not more than 3.0% salt.

RECOMMENDED MINIMUM DRAINED WEIGHTS, IN OUNCES, OF PICKLES

Container size or designation	Sour Whole, Cut, Mixed, and Dill Pickles	Sweet Whole, Cut, and Mixed Pickles	Sweet Pickle Relish
Pint (16 ounces)	..	11	14
Quart (32 ounces)	17	22	28
Gallon (128 ounces)	85	90	112
No. 2½ can	17	21	25½
No. 10 can	72	76	94
No. 12 can	85	90	112

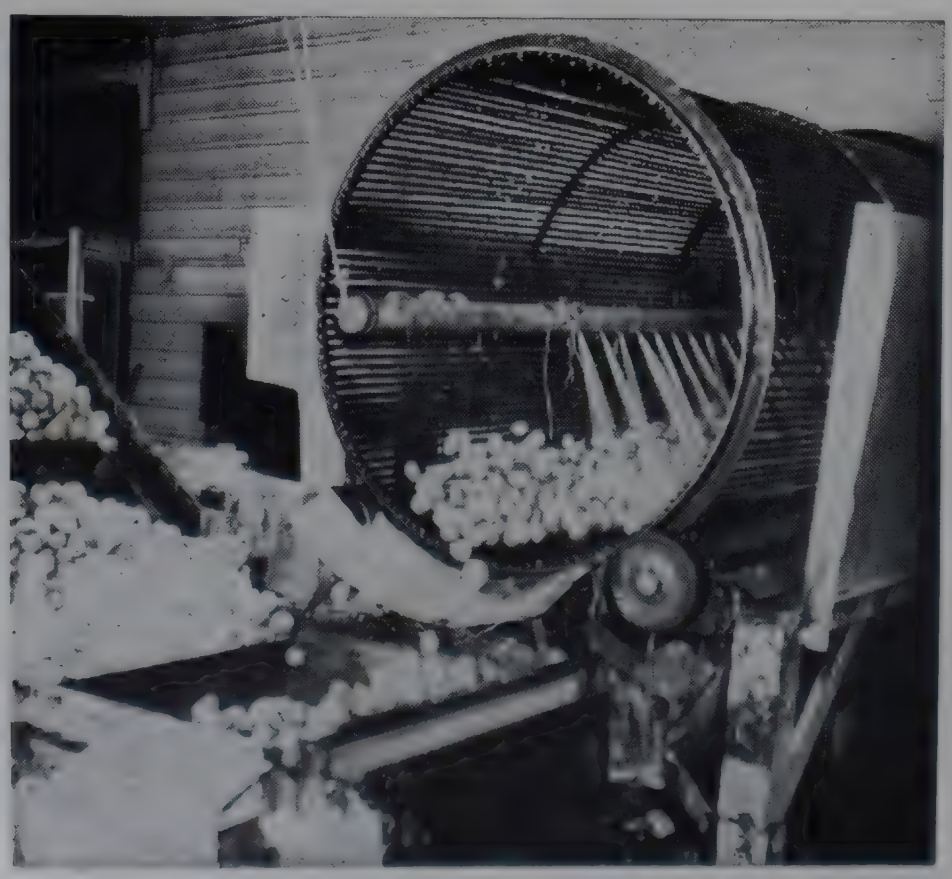
Sizes of Cucumber Pickles in Whole Cucumber Pickles

The size of any whole cucumber pickle is determined by measuring the shortest diameter transverse to the longitudinal axis at the thickest portion of the pickle and by measuring the distance from stem to blossom end.

Sizes of Cross Cut or Sliced Cucumber Pickles

The size of any unit cut at right angles to the longitudinal axis is determined by measuring the shortest diameter of the surface of the unit. The size of any unit cut longitudinally is determined by measuring the longest distance parallel to the longitudinal axis.

Rotary, squirrel cage washer cleans raw product with a high pressure spray before it is conveyed to inspection lines.



Section 4—Mayonnaise And Other Oil Dressings

MAYONNAISE is made by any one of the following methods: by the use of a beating machine, homogenizer (viscolizer), or vacuum process.

It is usually considered as the product made by the proper incorporation of vinegar, oil, egg, salt, mustard and other spices; whereas, salad dressing is made with about the same ingredients using less oil, adding more emulsifying agents such as gums or starches, with the thickeners very often cooked before being added.

There seems to be some dispute as to the origin of the term mayonnaise, whether it was named for Port Mahon, where the Duc de Richelieu, marshal of France in the seventeenth century, defeated the English. In honor of this event he named the dressing for the historical spot. Others state that the dressing was the creation of a Frenchman named Mahon and named for him. Still another explanation is that it was first prepared at Bayonne, France, named "Bayonnaise" and later changed to "Mayonnaise." No matter under what circumstance this product was compounded it is certain that it was another creation of French culinary art.

Only in recent years has this product been produced and sold commercially. It is a true emulsion, of oil-in-water type, and is made without the aid of heat.

Mayonnaise, sold commercially, is the result of the application of household formulas or recipes increased many fold. It was considered a task to produce a stable commercial mayonnaise and at first many companies endeavoring to produce it, gave up the idea as being too uncertain. It has been only recently that this product has been formulated scientifically; thus its manufacture has progressed greatly.

COMPOSITION:—Mayonnaise is a colloidal product, being a stable emulsion in which edible oil in minute droplets is dispersed or suspended in water from the vinegar and egg. To produce a product that is stable and will not separate, in addition to the two immiscible liquids (oil and water) there must be a third substance, called the emulsifying agent which is usually a colloid; in the case of mayonnaise it is the protein of the egg. Other substances such as gelatine, flour, starch, milk, and gums are colloids that aid in stabilizing and preventing separation.

Analyses of various commercial mayonnaise and salad dressings show a great variation in the percentage of ingredients as noticed in the accompanying table.

As there is a difference in the chemical and physical properties of the various ingredients that enter into dressings, any formulas given may have to be modified. There is likely to be a greater variation in the eggs used than in any of the other ingredients.

In products such as these it would be well to understand thoroughly the raw materials used before learning methods and outlining troubles of making mayonnaise and salad dressings.

EGGS:—Some use whole eggs while the majority use only the yolks. Whole eggs contain approximately 75% moisture and 25% solids; whereas yolks contain about 50-55% moisture and 45-50% solids.

Chemical analyses show the character of eggs which may be of interest to manufacturers in order to check their purchases.

	Whole Egg	Whites	Yolk
Moisture	73.5%	86.0%	50.1%
Protein	13.5%	12.0%	15.5%
Fat	10.0%	0.2%	32.0%
Ash	1.0%	0.6%	1.1%

A more complete analysis of yolks and whites follow:

White		Yolk	
Moisture (water)..	86.2%	Moisture	49.5%
Fat Lecithin	Trace	Fat	18.0%
Protein	12.7%	Lecithin	11.0%
Dextrose	0.5%	Protein	14.5%
Ash	0.6%	Ash	1.0%

Commercially 43% solids is about the average for yolks. Should there be about 36% then an excessive amount of albumin may be present and a stable emulsion may become impossible to produce. The white or albumin in whole eggs has no special value as an emulsifying agent and usually produces a much lighter colored product and consequently is seldom used. Yolks for mayonnaise are specially selected for their dark rich golden or orange color and a premium paid for the proper yolk. To produce the rich creamy golden color it is necessary that the orange yolk be used. The coloring matter of egg yolk is lutein, a complex substance resembling carotin.

Due to the impracticability of making all the year's pack of mayonnaise when the egg cost is low, frozen yolks packed in convenient size cans (30 pounds) are used. The best eggs are produced from about the middle of March to the middle of June when the chickens are healthy and the weather cool which prevents decomposition and evaporation. The yolks are then easily separated because the whites are firm and

ANALYSES OF MAYONNAISE AND SALAD DRESSINGS (FROM A.O.A.C. VOLUME V—NUMBER 2-1):

							ACIDITY						
				Reducing Sugar			Total	Volatile			Lecithin Phosphoric		%
Labeled as	Solids	Ash	Salt	Before Inv.	After Inv.	Sucrose	acetic	acetic	Nitrogen	Oil	acid	Starch	Starch
Salad Dressing	86.26	1.19	1.09	.06	.61	.61	.52	.51	.207	83.16	.107	Positive	3.08
	25.63	3.58	3.32	8.80	10.74	1.84	1.07	.86	.278	3.34	.035	Negative	
Mayonnaise	56.02	2.74	2.40	1.72	1.78	.06	1.03	.75	.318	46.93	.085	Negative	
Mayonnaise	88.37	.91	.64	.30	.44	.13	.41	.26	.218	85.22	.066	Negative	
Mayonnaise	88.73	.59	.30	none	none	none	.41	.29	.261	86.02	.081	Negative	
Salad (May) dressing.....	29.16	2.95	2.26	8.17	11.42	3.09	2.63	2.08	.736	6.94	.128	Negative	
Salad dressing, a mayonnaise	61.15	6.39	5.42	3.45	11.09	7.26	1.45	.83	.730	36.48	.085	Positive	.46
Salad (May) dressing.....	60.94	3.05	2.40	none	none	none	1.47	1.08	.593	52.91	0.161	Negative	
Mayonnaise	59.28	2.35	2.03	none	none	none	1.26	1.06	.468	52.83	.095	Negative	
Mayonnaise	36.36	3.15	2.73	3.24	12.31	8.62	1.89	1.60	.374	12.52	.106	Positive	4.42
Salad dressing	62.33	3.13	2.65	.07	.07	none	1.18	.89	.547	54.68	.145	Negative	

the yolk firm. Eggs broken and separated should be under the strictest sanitary control. The cups and utensils used should be repeatedly sterilized and the operator should see to his personal sanitation so that a clean sound product, low in bacterial count, can be produced. The broken eggs should be kept as cold as possible until frozen and should be kept in such a condition until ready for use. They are frozen at about 10° F. for several days and then held at 15° F. The addition of sugar or salt and even glycerine during the freezing will assist in keeping the yolk in a homogenous condition after thawing and prevents separation. Glycerine if added in sufficient amounts will act as a preservative but the results on the finished mayonnaise are not as good as when sugar and salt are used. Eggs spoil or ferment rapidly due to bacterial contamination and growth, therefore, the necessity of rapid freezing or preserving.

Mayonnaise is produced from untreated yolks, sugar treated yolks or salt treated yolks, provided all have same total solids, protein and lecithin. The yolk contains a substance, lecithin, which is responsible for the excellent emulsifying property of the yolk. When the frozen yolks are to be used they are withdrawn from the freezing room the preceding day and thawed slowly by placing in tanks of running water. This takes the chill out slowly and at the same time keeps them cool so that spoilage does not set in before they are to be used. If the frozen yolks are permitted to thaw at room temperature and not in cool water they may spoil before they can be used. If they are not thawed thoroughly before being used golden "specks" are found in the finished product which will not be absorbed by the mayonnaise.

Egg yolks as bought on the market may contain some whites, and necessitate the addition of a larger amount to the batch. They should be tested regularly especially as the price is about double that of whole eggs. Some use powdered dried egg yolks, but the resulting product is not as good as when fresh or frozen yolks are used.

VINEGAR:—White distilled vinegar is the one most invariably used in commercial mayonnaise. Cider or malt may be used but they add to the cost and give a special flavor which does not seem to be favored. Special flavor is attained by special spicing or special spiced vinegar such as malt and tarragon to register acidity and to give the product the proper zest.

The only difference in vinegar may be in the flavor imparted to the finished product. There is no doubt that malt or cider does give a better flavor.

Vinegar has some antiseptic properties, otherwise mayonnaise would spoil due to the development of yeast, mold and bacteria. In selecting a vinegar be sure that it is extremely low in metals such as iron and copper so that the mayonnaise is not affected. Vinegar also helps to prevent the formation of rancidity.

OIL:—Oils used make a great difference in the product. Only oils that are sweet and free from rancidity should be used. Some object to the use of cottonseed oil because of the flavor and rancidity developed, and prefer using corn or sesame or a blend of various oils.

Many different kinds of edible vegetable oils can be used for mayonnaise and salad dressing. Among them are olive, peanut, sesame, cotton and corn oil. Due to price as well as adaptability corn and cotton seed oil, separately or blended, are used almost universally. Olive oil was first used in making mayonnaise but was too expensive, although it made a very palatable product. Olive oil will become rancid more quickly than the other oils used in such products. It also congeals at a high temperature and if chilled to remove the [illegible] then the flavor is changed. It will not hold water [illegible] as readily as other oils, consequently will cause [illegible]

PEANUT OIL has been advocated for mayonnaise and [illegible]

Piston fillers in action on a mayonnaise production line. Absolute sanitation is essential in salad dressing operations.

remove its strong flavor of raw peanuts. If carefully prepared from selected nuts it has a very palatable odor and taste and is delicious.

SESAME OIL was used at first, but has been replaced by our own oils. When freshly pressed it has a pleasant flavor with a "nutty" taste and is neutral and one of the finest of oils. It is rather stable and has better cold properties than the ordinary cottonseed oil. Price is one of the reasons it is not used now.

MUSTARD SEED OIL is another palatable oil, but there is insufficient production in this country to even give it any thought.

COTTONSEED OIL is one of the inexpensive high grade oils used, commercially known as "Winter Oil" or Salad Oil because it will not cloud or become solid at ordinary winter temperature and should be able to withstand a temperature of 32° F. for five hours without clouding. The oil after being pressed and purified is chilled to remove the palmitin and stearin. This gives an oil with the lowest possible free acid content because it has been found that free fatty acids act as a catalyser and start the formation of rancidity.

CORN OIL is preferred because of lower cold test. This is due to the chemical composition which permits its use in much colder climates. Its congealing point is 15° F. which is much lower than other oils. Thus, it can be used without danger of separation. It also contains sterols, lecithin and other compounds which aid in stabilizing the emulsion and prevents separation at high temperature. Oxidation is also retarded. Climatic conditions to a certain extent govern its use because corn oil is very desirable for regions where freezing is common while cottonseed oil is better for regions where the temperature is higher. Some firms, especially in the north, prefer using corn oil in the winter time and cottonseed oil in the summer or often blending the two.

High grade oil should be properly protected when received at the factory. If received in barrels or drums they should be stored in a clean, dry, cool warehouse and when used should be carefully cleaned to remove any extraneous dirt so it will not fall into the oil. The container should be closed as soon as the portion of oil needed is removed. This will prevent or retard oxidation and rancidity. If the oil is received in tank cars then the receiving tanks should be kept in a dry cool warehouse and if possible cleaned before any new oil is placed in them. In opening the tank of oil either [illegible]

dirt, dust or cinders from the air vent, manholes or valves so the dirt will not fall into the oil. Oil received in tank cars in the winter time may arrive in a frozen condition and must be thawed carefully. Too rapid or too high steam pressure may scorch the oil and affect the flavor. The steam connections should be tight so there will be no leak and permit water to enter or the oil to enter the steam line.

Vegetable lecithin when used in oils is also an anti-oxidant and may aid in the prevention of rancidity if used in amounts of 0.05-0.1% by weight of oil.

The manufacturers of mayonnaise are beginning to standardize the raw materials that enter into the manufacture of their product and only buy according to specifications. The oils used must meet rigid inspection, especially as to rancidity and the Kreis test.

SUGAR used, should be highly refined either cane or beet and free from yeast, spores or bacteria so as to minimize the danger of spoilage.

SALT used, should also be high grade and free from impurities because it may form combinations in the finished product and affect its stability. The presence of lime salts may tend to produce "greasy" emulsion and an unsuitable product. The finer the grain of the salt the easier it goes into solution. Test the salt to see if it has any stabilizers that prevent caking, such as phosphate, starch, plaster of Paris, etc. Mix a portion with water and if it becomes cloudy or milky do not use it for the manufacture of any commercial food product.

GELATINE:—Edible gelatine has been used in small amounts as an aid to stabilization, but, it is not necessary to use it if the right proportions of oil, egg, vinegar, etc., are used. When gelatine is used it should be of about the same high quality that is used for ice cream. Mix the gelatine with cold water or cold vinegar and then heat in a double boiler until dissolved. Add it when the formula calls for water or vinegar.

The consistency of the mayonnaise is affected, when gelatine is used, by weather conditions. If the weather is very warm, the mayonnaise seems to "thin out" but when the weather is cold the mayonnaise becomes "quite stiff." It would be almost impossible to regulate the consistency to suit weather conditions because mayonnaise is often held for several months before being sold.

SPICES:—There are very few spices used in mayonnaise; the principal ones are powdered mustard, white pepper and paprika. White pepper is preferred because it does not introduce color or "specks" into the finished product as would black pepper. Paprika gives mayonnaise a slight pink color, but it has been found that it often causes spoilage due to contamination with yeast and bacteria, so that if spoilage should occur, have the paprika examined.

MUSTARD:—Powdered mustard or flour is used in mayonnaise. It is prepared from the seed by largely removing the hulls and often some fixed oil is removed by pressing in cool temperature because the fixed oil, especially that from the yellow seed, has a tendency to become rancid. It is thought that the removal of this oil will also prevent some of the discoloration due to oxygen absorption on the surface of the finished product. Mustard contains certain compounds which cause the oil to absorb more oxygen and therefore a rapid discoloration; thus the partial removal of the fixed oil. A special mustard sold for mayonnaise should be used.

Nature produces different flavored mustards. Due to drought, rain, heat, cold, soil, different localities and different countries, method of farming, etc., it is almost impossible to have mustard seed that would be constant each year for flavor, emulsifying property, etc. It is possible by careful blending of seeds to have a result which will be almost constant. It is advocated that manufacturers endeavor to buy mustard that will give them constant and uniform results both from flavor and emulsifying properties. A blend of the black and yellow powdered mustard is made that will give the desired flavor. Sometimes these important factors are ignored because of price. As the brown seeds contain approximately 36% oil and the yellow about 31% the removal of the most of this oil would naturally produce a "hotter" product in the powder.

Mustard has been found to be highly contaminated with bacteria and mold, therefore, the necessity of selecting a quality flour to prevent spoilage in the finished mayonnaise.

It is now well known that mustard has emulsifying properties aside from its flavor that makes it valuable.

The following is approximately the composition of mayonnaise:

Eggs	6.85%
Mustard	0.76%
Sugar	0.64%
Salt	0.98%
Spices	0.24%
Oil	82.00%
Vinegar	6.66%
Water	1.87%
	100.00%

USING BEATERS:—There are several types of effective machines for making mayonnaise and salad dressings, having an oil attachment so that the oil may be added slowly in order to make a more stable emulsion.

The following formula for mayonnaise can be used and modified to suit the price requirements:

MAYONNAISE

Egg yolks	5 pounds	4 pounds	3 pounds
Oil	17½ lbs. = 2¼ gallons	2½ gallons	2½ gallons
Vinegar (45-grain)	1¼ quarts	1¼ quarts	1¼ quarts
Sugar	10 ounces	10 ounces	10 ounces
Mustard (powdered)	4 ounces	4 ounces	4 ounces
Salt	6 ounces	6 ounces	6 ounces
White pepper	½ ounce	½ ounce	½ ounce
Paprika	½ ounce	½ ounce	½ ounce
Water		1 pint	1 pint
Yield	25 pounds	26 pounds	28 pounds
Per cent oil	70.0	67.30	62.5
Per cent egg yolk	20.0	15.38	10.7
Total per cent	90.0	82.68	73.2

THICK MAYONNAISE

Frozen egg yolk	19 pounds
Oil	10 gallons
Salt	24 ounces
Sugar	20 ounces
Mustard flour	8 ounces
90-"grain" vinegar	6½ pints
Water	2½ pints

SPICED VINEGAR FOR MAYONNAISE AND SALAD DRESSING

100-"grain" white vinegar	20 gallons
Water	17 gallons
Mixed spices (see below)	13¾ pounds
Chopped garlic	11 ounces

MIXED SPICES FOR THE SPICED VINEGAR

Ground cayenne	1½ pounds
Ground ginger	2 pounds
Ground clove	3 pounds
Ground mace	½ pound
Ground coriander	3 pounds
Ground mustard	3 pounds
Ground cardamon	½ pound
Ground bay leaves	1½ pounds
Ground caraway	3¼ ounces

The spices should be leached for about one week before

Screw caps, placed on jars by hand, are given just the right amount of twist to seal by these machines in a modern plant.

using in order to extract the flavor.

It requires 2 dozen eggs to produce 1 pound of yolk; 20 eggs to produce 2 pounds of yolks and whites. One dozen eggs will produce about 1 pint of broken eggs. One gallon of oil weighs 7⅝ to 7¾ pounds.

GENERAL MIXING PROCEDURE:—Place the egg in the beating machine and beat until smooth, then add the mustard and continue beating until mixed. Follow this by the slow addition of oil from the storage tank while still beating, then add the other ingredients mixed in the vinegar and water, at the rate of about 1 quart to every gallon of oil used. Complete the addition of the oil before the entire amount of vinegar has been added.

Be careful not to allow any oil to fall into the finished batch as it will cause separation. Fill, and cap the product as soon as possible. As this is a very heavy product, it will not stand up for more than 3 to 4 months, consequently a dealer should not be sold large amounts. Handle the filled cases gently, as sudden jarring may start separation.

VISCOLIZER, OR HOMOGENIZER:—This machine has a very fine orifice through which the product is forced under great pressure, thus dividing the oil into extremely fine droplets that are kept separated by the water and the emulsifying agent so they cannot coalesce and separate.

The product must first be beaten or mixed before it is run through the machine.

MAYONNAISE MIXERS OR EMULSIFIERS:—In order to put the ingredients into the form of mayonnaise, it is necessary to make an emulsion of the oil, in which the oil is in small globules. This is accomplished by machines, constructed for this particular purpose, and several types of emulsifiers are available in the market.

There are several commercial machines which vary largely [illegible] action. The majority of emulsifiers consist of a [illegible] bowl with a beater which revolves in the bowl, at [illegible] through the action of an electric motor. An[illegible] of emulsifier, consists of a glass enamel tank with [illegible] machine has a special type of emulsifier agitator, [illegible] blades which act to reduce the fat globules [illegible] operated by a motor, [illegible] of a wooden

metal bound tub, which revolves by means of a motor, around a stationary agitator.

Oil tanks are supplied with all types of mayonnaise mixers and are equipped with valves which permit the regulation of oil flow.

MAYONNAISE—VACUUM PROCESS:—A method for making mayonnaise has been advocated, using a vacuum in addition to the preliminary beating of the ingredients to embody them.

The equipment is a glass lined tank either with or without a jacket in case the product is to be cooked. It is a closed machine that holds a 35-gallon batch with the emulsifying process done under vacuum without any waste from splashing. The vacuum system of operating is nearly automatic from start to finish.

As the tank is glass lined it can be thoroughly cleaned and sterilized before and after using, which makes it a sanitary process.

Simplicity of design is one of the most important features of any equipment used in making salad dressings. This equipment has an emulsifying agitator of simple design, being the only moving part in the machine and it can also be easily and quickly cleaned.

As the tank is of closed construction, it eliminates splashing and loss of product and permits absolute sterilization of the tank before starting the operation. Air is also excluded throughout the mixing operation, which retards bacterial development and oxidation of the oil and thus prevents spoilage and rancidity so the product will keep for a longer time.

This system of beating under vacuum seems to produce a dressing in which the oil is suspended in finer droplets than is usually the case of dressings made under the same conditions only using an open beater. In the vacuum process, the particles still maintain uniformity and fineness of division, whereas the open process shows that there is an agglomeration of oil globules, indicating an incomplete emulsification.

PROCESS OPERATION:—Any of the mayonnaise or salad dressing formulae may be used under this system. The eggs, spices, vinegar, sugar, salt, and water are put into the machine and thoroughly incorporated for five minutes, running the agitator at low speed of 125 R.P.M. Then the valve of the oil reservoir is opened slightly and while it is running into the mixer, the agitator is run at 250 R.P.M. To start the running of the oil from the reservoir tank to the emulsifier, the valve on the vacuum line is "cracked" to exhaust the air from the mixer, and prevents the product from being pulled out of the mixer into the pump. At the expiration of two minutes, open the valve wide. When all of the oil has been delivered, then close the oil valve and continue the beating under 25 to 27 inches of vacuum during the balance of the emulsifying period which is usually about 20 to 30 minutes.

USE OF PURE CONCENTRATED LEMON JUICE IN MAYONNAISE

Ingredients	Amounts	Per Cent by Weight
Salad oil	20¼ lbs.	81.1
Egg yolk	2 lbs.	8.0
Sugar	4¾ ozs.	1.2
Salt	4¾ ozs.	1.2
Mustard	2½ ozs.	0.6
Pure concentrated lemon juice	2 fl. ozs.	0.5
Water	11 fl. ozs.	2.7
50-Grain vinegar	19 fl. ozs.	4.7
Total	25 lbs.	100.0

Add the sugar, salt, mustard, egg yolks, and about half the amount of water specified to the mixer bowl. Beat at low speed until the ingredients are thoroughly mixed. The beater is then shifted to high speed and the oil is added slowly at first until the emulsion is well established.

the oil can be added more rapidly. If the mayonnaise becomes too heavy during the addition of the oil, add the remainder of the water and, if that is insufficient, use some of the vinegar. When all of the oil has been added (which ordinarily requires from 20 to 30 minutes), the pure concentrated lemon juice and vinegar are added and the batch is mixed very thoroughly to obtain uniformity. The mayonnaise is then allowed to stand in the mixer bowl for a minute. Then stir for one minute more. Mayonnaise is now ready to be packaged into containers.

SALAD DRESSING is the wholly or partly cooked or boiled semi-solid emulsion of edible vegetable oil, egg yolk, a vinegar, water and/or lemon juice, with one or more of the following: salt, other seasoning commonly used in its preparation, sugar and/or dextrose, starches or other edible moisture absorbing agents; and without artificial color. Any other sugar for which a standard has been established, and unrefined milk sugar, may be used. Where any edible moisture absorbing agents are used, the same must be declared on the label. The finished product contains not less than 35% by weight of edible vegetable oil.

SALAD DRESSING

Corn starch	2 pounds
Salt	6½ ounces
Frozen egg yolk	2 pounds
Mayonnaise mustard	6 ounces
Sugar	11 ounces
Paprika	½ ounce
White pepper	½ ounce
Ginger	½ ounce
Nutmeg	½ ounce
White vinegar (50 grain)	2¾ pints
Corn oil	2 gallons
Garlic vinegar	½ ounce

METHOD OF MANUFACTURING:—Heat 1½ gallons of water. When hot add the corn starch which has been mixed with ½ gallon of cold water and cook until clear. This should yield about 19 pounds.

Mix the egg yolk, mustard, spices, and beat. Then add ¾ pint of vinegar, pour in the oil slowly and when 1½ gallons have been added, add 1 pint of vinegar and then the balance of the oil and the rest of the vinegar and salt.

Slowly add the starch paste, when it is cold, and mix well. Beat until smooth.

The following is another salad dressing formula which is not so highly spiced, but makes a very fine product:

Corn starch	5¼ ounces
Water	80 ounces
Salt	2⅛ ounces
Vinegar	10 ounces
Mustard—powdered	¾ ounce
Cayenne pepper or paprika	dash
Egg yolk	12⅓ ounces
Oil—corn or cottonseed	80 ounces
Percentage of oil	41.88 per cent

Directions for making corn starch paste: Heat 64 ounces (½ gallon) of water and add the salt; when boiling, add the corn starch which has been stirred into the remaining cold water (1 pint). Cook the starch until transparent. When cold, the thickness should resemble that of mayonnaise.

Directions for making the dressing: Add the cayenne or paprika, and mustard to the egg yolk and beat. Add ½ of the vinegar slowly and then the oil, in small quantities at first, beating constantly. As the mixture thickens, gradually add the rest of the vinegar and oil and continue the beating until all of the oil and vinegar are used. When finished the dressing resembles whipped cream in texture. If preferred, the dry ingredients may be added to the egg yolk, then well mixed and the oil added slowly until the product thickens, then add faster until all of the oil has been added. Then add the vinegar to thin out the product.

Combination: After the corn starch paste is cold, blend the two by thoroughly beating.

Formula: 1st Part

Mustard flour	4 pounds
Starch	6 pounds
Salt	6 pounds
Sugar	13 pounds
Water	4 gallons
Spiced vinegar	4½ gallons

Mix all of these ingredients in the beater using the slow speed, then remove and run live steam into the mix (be sure and blow out all of the condensed steam from the line first) and cook until it begins to thicken or spatter. Then cool by standing in a tub of cold running water, stirring occasionally.

2nd Part

Powdered egg yolk	4 pounds
Oil	2¾ gallons
Turmeric	2 ounces
Water	1⅛ gallons

Place the egg and turmeric in the beater, add 6 pints of water and beat for 5 to 6 minutes using the high speed, and then add 1 gallon of oil slowly and after the first gallon of oil has been added, the balance of the water may be added 6 ounces at a time while the remainder of the oil is slowly running in. Beat for about 10 minutes after all of the ingredients have been added. Then add part 1, and again beat for at least ten minutes. Fill into jars and can immediately. On account of the egg, it may be necessary to add some powdered gum tragacanth (about 1½ pounds for this size batch) or increase the starch.

SALAD DRESSING

Powdered whole egg	1½ pounds
Powdered egg yolk	1 pound
Oil	3 gallons
Salt	2 pounds
Vinegar, 100 "grain"	1 quart
Powdered mustard	6 ounces
Sugar	5 pounds
Paprika	½ ounce
Powdered ginger	½ ounce
Powdered nutmeg	1 ounce
Garlic vinegar (same as used in mustard)	1 ounce
Oil of lemon	2 c.c.
Corn starch	5 pounds
Water	5 gallons

Dissolve the salt and sugar in about 4 gallons of water and, when boiling, add the corn starch that has been previously mixed in a gallon of cold water. Cook until transparent, being careful so that it does not stick or burn, then cool. Place the oil in the beater and add the powdered egg and powdered spices, and beat until perfectly smooth, then slowly add the vinegar, oil of lemon, garlic, and finally the corn starch. Beat until perfectly smooth and continue for at least ten minutes more. This has a good flavor. The same spicing can be used in any of the mayonnaise and salad dressing formulas.

Cooked Salad Dressing: Part 1

Powdered egg yolk	1½ pounds
Water	4½ pints
Oil	1⅜ gallons

Place the egg in the beater, add the water and beat until

smooth before slowly adding the oil.

Part 2

Starch	3 pounds
Water (cold)	1 gallon

Mix together and add to the following:

Part 3

Spiced vinegar	2¼ gallons
Water	1 gallon
Salt	3 pounds
Sugar	6½ pounds
Mustard flour	1⅞ pounds

Mix the ingredients well and place in a vessel and steam until thick, then cool. Add this paste to part 1, and beat for at least 10 or 15 minutes.

MUSTARD RELISH

Vinegar 90 "grain"	11 gallons
Starch	12½ pounds
Mustard flour	12½ pounds
Turmeric	½ pound
Sugar	17½ pounds
Salt	7 pounds
Water	5 gallons

SANDWICH SPREAD:—This is made by draining and pressing sweet relish that has aged, after removing the excess liquor. Mix the relish with either salad dressing or mayonnaise. Five gallons of relish weighing 47½ pounds yielded 28½ pounds of dry relish. To 25 pounds of drained relish mix with 37½ pounds of mayonnaise or salad dressing. Bottle and cap immediately.

Unless the raw materials are carefully selected and properly blended spoilage is quite apt to occur. The use of alum salts in pickles used for this spread has often been blamed for fermentation. It is probably due to poor quality pickles which have not been properly prepared, especially in removing the wild yeast. The spoilage is more apt to be due to the use of sweet peppers that have been kept in salt brine and not properly washed and transferred to 100 "grain" vinegar for sometime before using. The broken pieces are often pregnated with myriads of yeast and bacteria which if not removed will cause fermentation in sweet relish or in the finished spread. The spoilage can also be caused by infected mustard, pepper, or paprika. If such spoilage does occur, the spice can be cooked or boiled with vinegar for a short time before being used. Spoilage is often due to contaminated corn starch or other starchy material. The manufacturer should be careful in his handling procedures.

Spoilage is apt to occur due to separation of the oil and also to metallic contamination from iron, copper, zinc and nickel. This may be due to the action of the vinegar on the metal containers, pipes or beater.

NON-FATTENING DRESSINGS:— Due to obesity, some prefer using a dressing for their salads that does not have a tendency to increase their weight. Such products have been called "Non-fattening Mayonnaise." This expression has been objected to, especially the term "mayonnaise" because it is a standard and definite product. By using about 85% mineral oil, 5% egg yolk, 1% mayonnaise, mustard, vinegar, spices, and making according to the general directions under the different mayonnaise formulas, a product can be made that may suit some people. By using any of the first three formulas grouped together under mayonnaise and substituting mineral oil for the vegetable oil, a good product of this character can be made.

AVOCADO MAYONNAISE is a new product made by mixing avocado pulp with mayonnaise just as the sandwich spread is made. Use 6 ounces of pulp from tree ripened avocados for each one half pint jar.

Poor quality of unstabilized mayonnaise may be attributed to poor raw materials and improper method of combining the ingredients.

It seems simple to take the ingredients that are used in mayonnaise and salad dressing and produce a high grade finished product. Such is not the case because there are so many factors that will influence the results that some of these should be discussed here.

1. Sodium potassium tartrate known and sold as Rochelle Salt, which is alkaline in character, should not be used in mayonnaise, because instead of stabilizing, it will neutralize the acidity and may permit rancidity and fermentation.

2. Use only sweet refined oil that meets the requirements as outlined under "oil." In selecting oils for mayonnaise, it is well to select only those that are neutral and bland and do not become rancid quickly. Sesame, soya, and corn oils are very good although more expensive than cottonseed oil.

3. Clean dry spices free from weevils, larva and worms, and other insect fragments should be used. It is well to check the spice for organisms that cause spoilage. Keep in metal containers or closed bins and off the floor.

4. Keep the metallic content of the finished product as low as possible because iron and copper salts act as catalysts or accelerators and decrease the induction period of the oil and make it more susceptible to oxidation or rancidity. It has been found that copper in amounts 1:100000 is active in forming rancidity. The same also applies to iron so it is well not to permit the ingredients used or in the process of manufacturing to come in contact with these metals. Tin and aluminum do not affect the product. If possible, glass-lined or enameled tanks, lines, etc., should only be used. Watch the beating bowl to see that the tinning is not removed and if so have it retinned at once.

5. Cleanliness cannot be stressed too much in the plants making both salad dressing and mayonnaise. All of the equipment should be scrupulously cleaned to remove all traces of oil, sugar, mustard, etc. Keep the oil tanks closed and clean on the outside as well as all oil barrels. Wash and thoroughly dry the mixing bowls, spoons, spatulas, filling and beating machines. Usually the equipment is rinsed first with water and then washed with an alkaline solution such as lye, soda, ash, sodium phosphate or any good detergent. Rinse thoroughly with water to remove any danger of free alkali remaining because it may form a soap with the alkali and give an off flavor. Starch paste will "sour" or spoil very quickly and the great number of bacteria may inoculate fresh material and the spoilage process continue until the entire finished product is infected.

6. Keep eggs in a cool place so slow fermentation or spoilage will not develop before the product is used.

7. Protect the vinegar, pickles or relish and olives from vinegar flies and development of yeast and spores.

8. Spoilage may be due to fermentation, mold development, rancidity, separation, and discoloration. Especially is this true in dressings that contain sugar and such vegetables as pickles, onions, tomatoes, etc. By keeping the moisture content between 15 and 20%, trouble may be avoided. The product should be filled and capped immediately; preferably with a vacuum seal in order to exclude air, thus preventing molding and rancidity.

9. Separation causes greater loss to the manufacturer than any other trouble. Mayonnaise may have oil separation or water separation. The water may separate out at the bottom or the oil separate out at the top. Water separates out slowly and usually takes several weeks. Oil separation may be due to the loss of moisture which changes the character of the product and permits the oil globules to run together. Oil separation may be due to improper combination of the ingredients, freezing, very hot weather for an extended period, rough handling in shipping, or drops of free oil in the finished product. Some manufacturers subject their product to such

mixture as well as very hot water. They know if the product will stand up without separation under these tests that it will withstand any handling it may receive by the trade. By keeping the water content in the finished goods below 20%, they lessen the tendency to separate. All shipments should be protected from freezing.

10. Discoloration usually starts at the top surface of the jars and extends downward until the entire jar is affected. It may be due partly to the presence of iron salts and free air. Careful sealing and filling the jars full to eliminate air space will to a large extent reduce this loss to a minimum. Some seal under vacuum and use carbon dioxide gas to remove trapped air. While this method has been patented yet nitrogen gas can also be used to prevent oxidation.

11. Rancidity which occurs in these products is due to complicated changes which take place in the oil. It is usually caused by oxidation of the oil due to the presence of traces of fatty acids, improper storage, exclusion of air and the presence of iron and copper, which act as catalyzers and accelerate the formation of acids which give the off odor and taste.

12. Fermentation or decomposition is usually due to infected raw materials such as spices (mustard, paprika, ginger, pepper, etc.), sugar, and eggs. Good spices from clean raw materials instead of causing spoilage should aid in preventing it. Fermentation is usually caused by yeast, bacteria, molds, or a combination of several. Keeping the acidity high enough will often prevent such spoilage because the bacteria will not develop in high acidity. Again the trouble may be caused by improperly cleaning the utensils and containers. Yeast growth is not checked by the acidity present, neither is mold but a low water content will often prevent any such spoilage. Mold is a surface grower and if the jars are well filled and properly capped such trouble is avoided. Eggs improperly refrigerated may have spoilage started before they are used.

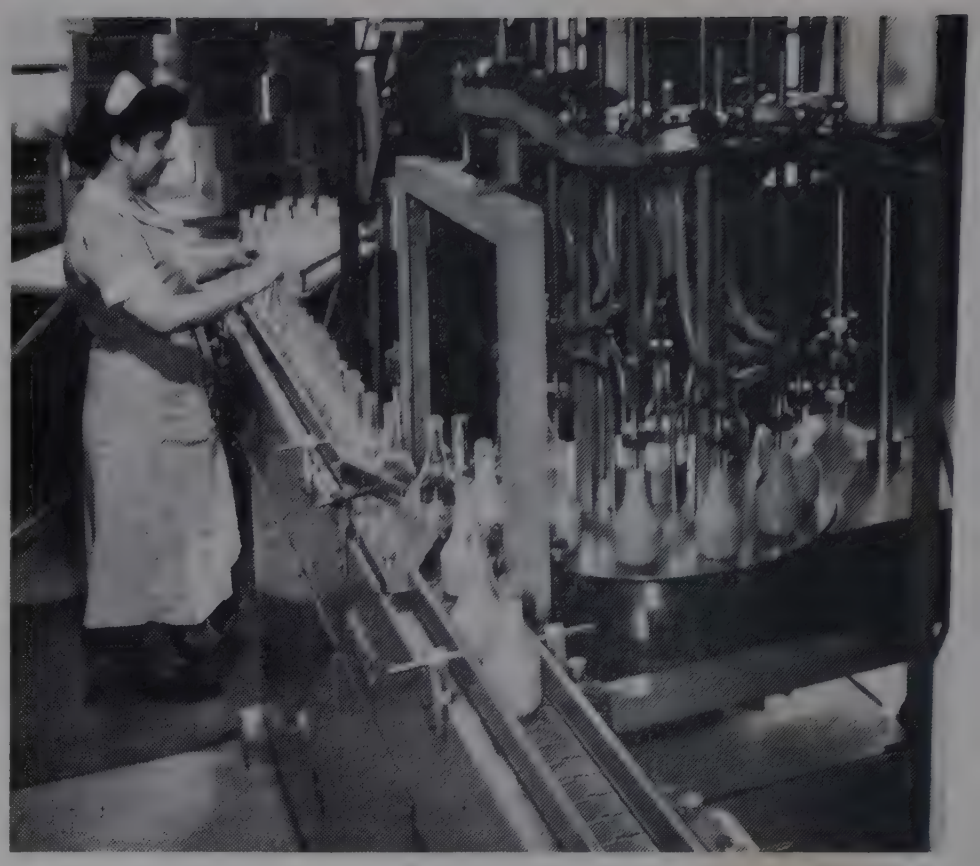
13. Freezing for a long period or very low temperature and thawing and freezing again may cause oil separation in mayonnaise that has been made under perfect conditions. Some of the factors influencing such a condition may be due to the improper amount of oil and yolk as well as kind of oil and quality of the eggs. It is well to test the finished product to withstand low temperatures because the product may be shipped in cold weather and caught in a blizzard where the temperature may go extremely low. As the glass jars used to pack mayonnaise have thick walls, they may break when subjected to low temperatures so it would be well to secure test tubes about 1 by 6 inches. Fill them about ½ to ¾ full and place in a properly controlled refrigerator or under some kind of refrigeration. Cool the sample to 32, 20, zero for two days and then allow them to slowly reach room temperature. A properly made mayonnaise will withstand the zero temperature without separation.

14. A filling machine should be selected that will give the proper capacity with the least exposed metal parts and minimum of air exposure.

FRENCH DRESSING:—A true French dressing is composed of a vinegar or lemon juice, an oil or blend of oils, with salt, sugar and paprika. The following will make a French dressing:

Salad oil	10 gallons
Vinegar	5 gallons
Salt	1⅞ pounds
Sugar	3¼ pounds
Paprika	½ pound

Some prefer cottonseed oil while others may use corn, sesame or soya or any good edible oil which does not develop rancidity quickly. Again malt or cider vinegar may be used, but commercially it is not often used because it adds more to the cost of the finished product. Some do not like sugar which need not be added.



French dressing being filled into jars by a rotary liquid filler. Conveyor in foreground is steel to eliminate instability.

There are some commercial dressings made by using mayonnaise as a base and adding oil and vinegar to reach the proper consistency. Gums are also used as stabilizers in making French dressing.

There are many other dressings that can be made using French dressing as the base or foundation. The following are some of the different dressings used and the formulas for them:

ANCHOVY DRESSING

French dressing	50 gallons
Anchovies, finely chopped	4 gallons

CHUTNEY DRESSING

French dressing	18 gallons
Chili sauce or chutney	6 gallons

Mix thoroughly.

CATSUP OR KETCHUP DRESSING

French dressing	18 gallons
Catsup	6 gallons

Mix thoroughly.

PIQUANTE DRESSING

French dressing	10 gallons
Powdered mustard	18 ounces
Worcestershire sauce	4½ ounces
Onion juice	18 ounces
Tabasco sauce	½ ounce

Mix thoroughly.

PARISIAN DRESSING

French dressing	10 gallons
Green peppers—chopped	13¼ pounds
Red peppers—chopped	13¼ pounds
Celery—chopped	13¼ pounds
Onions—chopped	6⅝ pounds
Parsley—chopped	6⅝ pounds

Mix well

SPINOSA DRESSING

French dressing	10 gallons
Capers	13¼ pounds
Stuffed olives—chopped	6⅝ pounds
Parsley—chopped	2 pounds

There is a great demand for oils to be used in making

mayonnaise and dressings. The chief requisites are that they will not become rancid and be palatable with no objectionable oily taste or odor.

Olive oil being too high priced for many, has caused the processor to turn to substitutes that are satisfactory, among which are soya, corn, cottonseed, sesame and peanut.

OIL BLEND

Cottonseed oil	85 parts
Peanut oil, cold pressed	10 parts
Olive oil	5 parts

Corn oil may be substituted for olive oil in the above formula to produce a nicely flavored oil blend with a nutty flavor, or may be used unblended for salads, as it has a very good flavor and can also be blended with cold pressed peanut oil.

As the oils are filtered and clear when shipped, it should not be necessary to filter again if the containers used are clean and dry. Fill into packages and close as soon as possible to prevent oxidation and rancidity. If necessary to filter, mechanical units can be employed with the addition of a small amount of infusorial earth. A pressure filter using papers is effective.

There are many fruit and vegetable oils that are being advocated for edible purposes, but on account of price and scarcity they are not extensively used.

Recently tea seed oil has been imported and blended with olive oil and sold as "pure olive oil." Because this oil is bland, it did not impart any "off" flavor, and as its color appeared normal for that of olive oil, it was successfully sold when blended as pure olive oil. The regular chemical and physical tests revealed nothing out of the ordinary and it was not until special tests had been worked out by the U. S. Food & Drug Administration that this practice was stopped.

A mayonnaise production line from blending to case packing.

Section 5—Miscellaneous Food Preparations

Peanut Butter

PEANUTS used in manufacturing butter are legumes whose fruit or seed mature beneath the surface of the soil, hence the name Arachis hypogea.

Peanut Butter is made by grinding well-roasted and carefully blanched peanuts with or without salt. A blend or mixture of Virginia and Spanish peanuts is usually employed in order to obtain the most desirable proportion of oil, and the proper consistency.

There are two different varieties of peanuts used; the Virginia and the Spanish. Often the Virginia "runner" is ground alone and produces a good butter. Analyses from the U. S. Department of Agriculture show a difference in the fat protein, and carbohydrates of the two as follows:

	Spanish	Virginia	Peanut Butter
Water	4.20	4.2	2.1
Ash	2.60	2.7	4.03
Fat	50.00	43.7	46.41
Protein (Nx 6.25)	26.0	29.0	28.66
Fiber	2.0	2.8	2.30
Carbohydrates	15.1	17.1	...
Calories	2870	2709	...
Sugar and Dextrine	.....	.....	6.13
Starch	.....	.....	6.15
Salt	.....	.....	3.23
Ash (Salt Free)	.....	.....	0.80

The Spanish is higher in fat and calories while the Virginia is higher in protein and carbohydrates.

From a vitamin standpoint peanuts have a fair amount of Vitamin A and goodly amount of Vitamin B with no Vitamin C present. In addition to these, they also contain iron, phosphates, and lime salts, and are indeed considered an excellent food. They are so rich in fat and protein that they may cause digestive disorder unless eaten with starchy foods.

To produce a high grade product, it is necessary that only the best of materials be used. The different types of nuts used may be graded in No. 1 and 2; No. 1 being perfect, unbroken kernels and No. 2 being split and broken kernels. No. 1 is more often used for salting, while No. 2 is more frequently used for butter, as it is not so expensive and the quality is just as good for this purpose as No. 1. Butter made from the Virginia nut is considered too dry while that made from the Spanish is too oily (or moist) so that a blend of the two produces a butter that gives more satisfactory results, having the desired smoothness, right amount of oil and fine flavor, because the dryer Virginia nuts absorb the excess oil of the Spanish nuts.

The nuts are often blended 33% Spanish and 67% Virginia with approximately 1-3% salt, but a blend of 40% Spanish and 60% Virginia will produce a better product.

In manufacturing peanut butter there are four major operations:

1. Roasting and cooling.
2. Blanching—split nut blanching.
3. Cleaning blanched nuts and hand picking.
4. Grinding.

Before any of these operations are started it is essential that clean, sound high quality nuts be used. It is seldom that the nuts for butter are roasted in their shells. It is the consensus of opinion that if they are roasted in the shell, they should never be shelled in the same building where peanut butter is being made, due to the dust and dirt present.

Due to difference in size, composition, etc., it is not advisable to roast the two kinds of nuts together but roast separately and blend when grinding the butter.

The proper equipment should be installed to handle the butter efficiently, throughout all steps. Consult the best manufacturer of this equipment before you start this business adventure and be guided by his judgment.

Like all industries, the manufacturers of peanut butter have sought to improve the quality of their product. They realize that it has been impossible to roast the nuts uniformly so that each batch has the same color and flavor that they desire. Heretofore they have depended upon a human being to tell when the peanuts have been roasted to the right color. Often, this has been impossible due to perhaps variation in the size and composition of the nuts and the temperature of the roaster due to variance in gas pressure. One has often seen very dark roasted nuts as well as very light ones in the same batch.

A new process is called the continuous roaster. The shelled nuts are roasted continuously by the new process in about 7½ to 8 minutes. The keeping quality of the finished butter is improved because the roasting temperature is not sufficient to rupture the oil cells nor to disintegrate the natural antioxidant oils in the raw peanuts. As the roast is dry, there is absolutely no scorching of any part of the kernel or the red skin.

Peanuts treated by this new method are superior to those roasted by the old process.

a. There is uniform development of the kernels from surface to center.

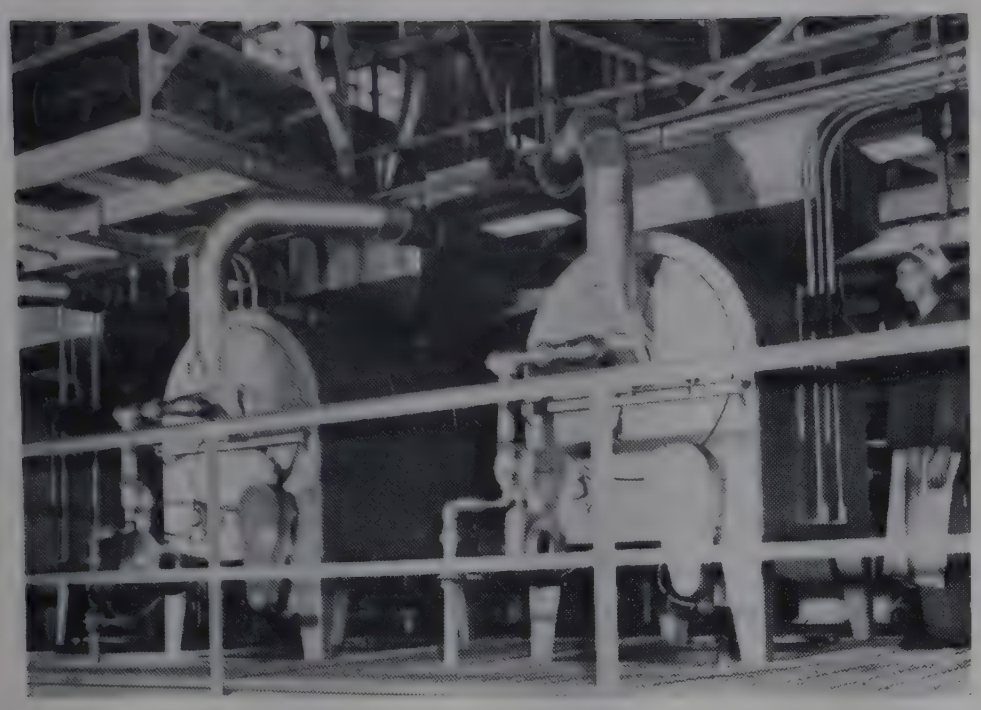
b. Uniformly and clear rich appearance of the whole day's production.

c. Freedom from scorching, excessive oiliness and blemishes.

The peanuts may be roasted to any desired color, and this degree of development is accurately controlled and uniformly maintained throughout the day's production. The process gives equal results for any type of roast—from the rich, brown color, required for certain kinds of peanut butter, to a very light roast ("white roast") for salting. The process materially reduces the proportion of split kernels and improves blanching.

COOLING:—In order to prevent further cooking the nuts must be quickly and efficiently cooled after roasting by passing air through them. This keeps the color and flavor uniform without the danger of an overroasted taste. The roasted nuts are dumped into a metal truck or car with perforated sides and bottom which is then connected to a chute equipped with a fan to draw air through the nuts. While this is being done, the next batch of nuts is being roasted. When cooled sufficiently the nuts are then ready for blanching.

In handling peanuts, as in all food products, a gravity system is preferable. On account of space, this cannot always



Roasting peanuts in a rotary roaster. Accelerated roasting loosens peanut skins and causes discoloration of the nuts.

be arranged, and the equipment may be placed on one or two floors.

The shelled nuts may be transferred by bucket conveyors or air blast to hoppers directly above the roasters and thence by gravity to the roasters.

ROASTING:—The roaster cylinder should have a smooth interior finish and geared to operate at low speed. The heating elements and draft should be so arranged as to be regulated accurately.

The raw nuts are either fed to the roaster from a batch hopper directly above the roaster inlet or else fed direct to the roaster. This often depends upon the amount of space that is available and the manner in which layouts can be arranged.

In roasting the temperature used is about 320° F. requiring 30-40 minutes to complete the operation. A temperature any higher is apt to scorch the nuts which will impart a burnt taste to the butter, whereas, if insufficiently roasted, the butter may have a raw taste. A light roast is preferable to many. It is by proper roasting that the desired flavor and color are developed and uniformity of quality is obtained for the entire batch.

Those who operate the roasters judge the finish by removing a few of the nuts and noting the color and texture, as well as the ease with which the red skins can be removed. The process must not be hurried so as to loosen or remove the red skin and thus cause discoloration of the roasted kernels.

BLANCHING:—This process removes the red skins, "hearts," stones, and other foreign matter. It is accomplished by passing the cooled nuts through special built machines equipped with brushes which revolve against corrugated plates. Blanching splits the nuts, removes the "hearts" or germ and the red skin. They are then screened and blown to remove the skins and germs.

This machine is called a "split-nut blancher" because it removes the red skins by rubbing, and the "hearts" by passing and splitting the kernels as they pass between a fixed corrugated plate and a revolving brush. The skins are blown into a collector and the hearts separated as the split nuts pass over a sieve. The hearts pass through the screen and are collected and sold for cattle feed or fertilizer. The blancher must be adjusted properly to remove all the skins and hearts.

Unless the skin is removed it will appear as red specks in the butter, and impart a bitter taste. The skins are bitter and astringent, but contain about 15% protein and 14% fat, and may be utilized as stock feed.

The germ or "heart" is rich in protein and fat, and may be expressed to remove the oil and the cake utilized for feed or fertilizer. If ground into the butter, the hearts will impart a bitter taste and cause rancidity and consequently must be removed. Peanut hearts may be used as chicken feed if mixed with other food, but are too rich to be fed straight. Care must be used in feeding the cake on account of the high protein and fat in order to prevent digestive disorders.

PICKING AND CLEANING:—Before the nuts are ground they must be carefully handled to remove stones, dirt, metallic objects and also any particles of chaff or skin still clinging to the nuts. Most of the foreign material to be removed is heavier than the nut. The split nuts are lifted by a current of air which permits the heavy objects such as nails, nuts, stones, and dirt to fall into a box at the bottom of the chute, while the nuts pass over into another chute where they are again blown lightly to remove the chaff.

PICKING:—The nuts are carefully picked to remove any defects by passing them over a sorting belt of the same style as used for picking beans. All moldy, shriveled and off-colored nuts must be removed as they will impart a musty or rancid taste to the butter. A few bad nuts can spoil a large quantity of butter.

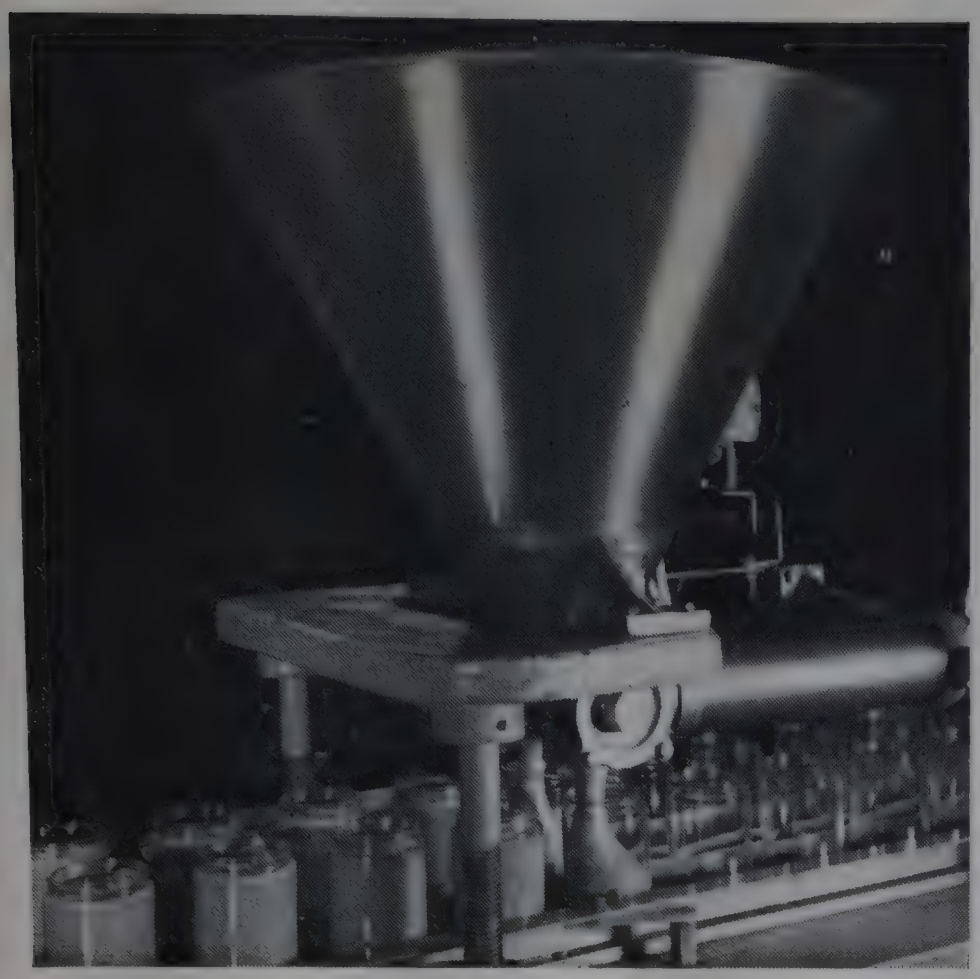
In large plants the roasted nuts are blended just as they are being fed to the grinder. Whereas, in small plants the nuts may be blended in the right proportion before they are roasted. A special blending or mixing machine can be obtained to give more uniform results.

GRINDING:—Peanut butter should be fine and granular rather than pasty, but if too fine, the butter sticks to the roof of the mouth. Whereas if too coarse, it is gritty.

The butter may be ground by passing the nuts between steel discs or else between granite stones similar to mustard stones. When stone mills are used, considerable heat is formed during the process of grinding. Thus the stones should be equipped with a water cooling device. The method of grinding by using granite stones produces an extremely smooth product uniformly salted by an attached automatic salting device.

There is often considerable separation of the oil, due to the fineness of the grind especially when the plate or stones become dull or worn, and also due to the variety of nuts used; some add a small amount of syrup or honey (about 1%) as the nuts are being fed to the grinder. This addition of the syrup aids in producing a more stable product or emulsion. The syrup used may be a plain cane syrup, invert syrup or honey. The equipment is so arranged that a fine stream of

Peanuts ready for blanching. This process removes "hearts" by splitting nut and removes the red skin by rubbing it.



Peanut butter jars pass through automatic filler on way to the cooling room. Quick processing and filling prevent rancidity.

syrup is constantly flowing into the hopper while the nuts are also entering. The addition of syrup may improve the flavor.

FILLING:—Most butter is filled into glass or cans as it comes from the grinders rather than using special fillers and rehandling.

In filling into glass, see that the jars are clean and free from dust and dirt acquired during shipment from the container manufacturer.

When filling, place the tip of the nozzle at the bottom of the jar and as the butter comes out lower the jar and give it a rotary motion so that all air is expelled and no pockets formed. It is necessary that the air be removed so that rancidity will not occur. If possible the jars should be sealed under vacuum and as soon as possible after being filled.

Endeavor to process the blanched nuts as rapidly as possible so as to retain the freshly roasted flavor, and thereby prevent them from becoming altogether stale and rancid.

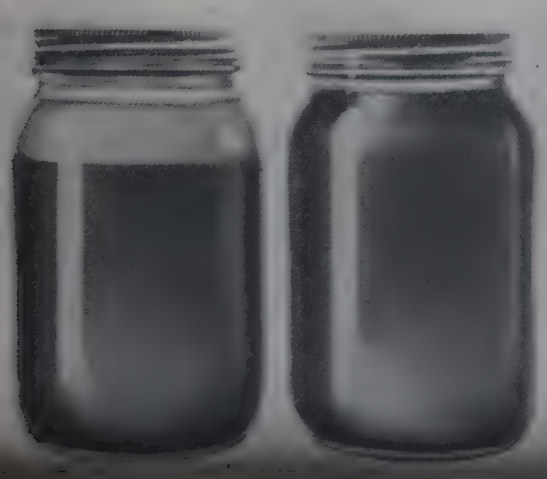
The butter is often packed in 10 and 20-pound cans with slip covers for certain trade, and may also be packed in barrels for large bulk trade. Unless the butter is used quickly, it is apt to become rancid or separate, especially in warm weather. Butter used for candy is often ground without salting. Unroasted peanuts that are kept during the warm weather must be placed in cold storage to prevent molding, development of weevils, and rancidity.

OTHER PROCESSES have been used for roasting peanuts. The first method patent paper was issued to Frank W. Stockton, U. S. 1395934 and the second was issued to Carleton Ellis, U. S. 1038545.

1st method:—Raw husked peanuts are submerged in heated hydrogenated peanut oil at 350° F. for 50 minutes, then drained and ground to butter. By this method, much of the natural oil is lost, being substituted by the hydrogenated peanut oil which prevents separation.

2nd method:—Roast the blended nuts, followed by submerging them in a hot hydrogenated peanut oil for 3 to 5 minutes; then grind into butter. This causes the peanuts to take up about 10% hydrogenated oil and prevents separation.

Peanut butter made in this manner can be packed in bricks similar to butter and cheese.



Several methods are used to "stabilize" peanut butter, i.e., prevent the separation of oil, shown in jar at left here. Patented stabilizers are available, usually made from hydrogenated peanut oil.

Types of Peanut Butter

Fine finish peanut butter means that the peanuts have been finely ground to produce a peanut butter of smooth texture.

Medium finish peanut butter means that the peanuts have been ground to produce a peanut butter of grainy texture.

Coarse (or "Chunky") finish means that the peanuts have been ground to produce a peanut butter of coarse, chunky texture.

Colors of Peanut Butter

Light roast means that the color is not darker than Plate 11, G-6 as illustrated in Maerz and Paul's "Dictionary of Color."

Heavy roast means that the color is darker than Plate 11, G-6 as illustrated in Maerz and Paul's "Dictionary of Color."

Syrups

Each section of the country has its own idea as to table syrup. In the New England states syrup is synonymous with maple syrup, whereas in the south, syrup is considered one of the products of the sugar cane or sorghum.

On account of the high cost of maple syrup a cheaper product is made by blending maple sugar or syrup with other syrups from granulated and corn sugars.

To produce a nicely flavored syrup, 12-15% of maple sugar or syrup is used. The use of some southern clarified or "C" mixed with cane and maple also helps to produce the desired flavor. Some prefer using 20-25% maple.

If maple syrup is used, then a 65% granulated sugar syrup is made and 12-15% by volume (or more if desired) of maple syrup added and mixed well. As maple syrup contains moisture or water, most manufacturers prefer to purchase maple sugar.

A plain syrup can be made by dissolving a 350 pound barrel of granulated sugar in 21 gallons of water.

Some add a slight amount of artificial maple flavor in addition to a little vanillin, but this flavor must be added judiciously. Too much of this flavor is worse than too little. When used the artificial flavor must be declared on the label, especially if maple is mentioned.

There is practically no fermentation or molding of syrup if the syrup tests about 65° Brix when cold. However, sterilize as an extra precaution.

Formula	Number 1	Number 2
Granulated sugar—pounds	300	200
Southern clarified or "C"—pounds.. ...		100
Maple sugar	50	50
Water—gallons	30	30

Heat the water and then dissolve the sugars by agitation and cook until the syrup tests 62° Brix hot or until the volume is 22 gallons.

It is well to boil the syrup gently for at least 10 minutes, replacing any water that may be reduced below the 22 gallons. Filter and fill into containers while product is hot.

Pasteurize at 160° F. for at least 30 minutes for pints.

The addition of 1 pound of salt per batch improves flavor.

An artificial maple syrup can be made by dissolving 8 pounds of sugar in ½ gallon of water and adding 1 to 2 ounces of maple extract, depending upon the strength of the extract.

MAPLE FLAVORED SYRUPS

Granulated sugar	200 pounds
Maple sugar	20 pounds
Salt	1 pound
Imitation maple flavor	8 ounces
Water	18 gallons

IMITATION MAPLE SYRUP

Granulated sugar	110 pounds
Brown sugar	100 pounds
Salt	1 pound
Imitation maple flavor	16 ounces
Water	18 gallons

The amounts of maple flavor are often reduced, depending upon the strength of the maple and the taste of the trade.

In order that the syrup be clear and clean, it is necessary to filter. If filtered hot, the life of the filter is longer, giving greater capacity. Unfiltered sugar syrup has a haze or cloudiness due to extremely fine suspended particles which must be removed in order to produce a syrup that appeals to the eye.

To produce the proper color and keep it uniform, caramel or burnt sugar is added. As brown sugar and maple impart some color to the syrup, it is not necessary to add as much as though the syrup were uncolored—about ¼ ounce of the coloring strength. The addition of a small amount of pure vanilla extract also aids in improving the quality.

Instead of using maple syrup or sugar a syrup is made by blending glucose and refiners' syrup. The refiners' syrup gives the glucose a slight flavor.

BLEND

500 pounds of 42° Bé glucose
16 gallons of refiners' syrup
2⅔ gallons of water

Heat to 180° F. for 30 minutes.

Sorghum or sorghum molasses is used in the south as a spread but "New Orleans molasses" is too strong to be used other than for baking.

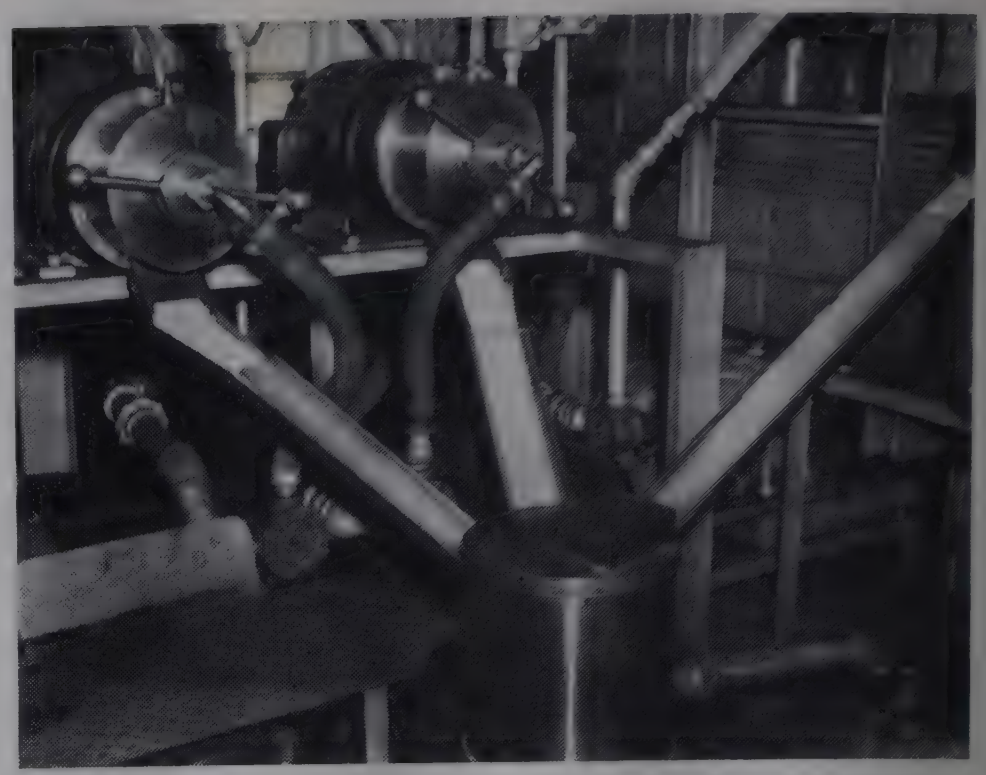
Maple syrup means syrup made by the evaporation of maple sap or by the solution of maple concrete (maple sugar) and contains not more than 35% water, and weighs not less than 11 pounds to the gallon (231 cubic inches).

Prepared Mustard

Prepared mustard is a paste composed of a mixture of ground mustard seed, mustard flour, or mustard cake, with salt, a vinegar, and with or without sugar, spices or other condiments. In the fat, salt, and sugar free solids, it contains not more than 24% carbohydrates, not more than 12% crude fiber, not less than 5.6% nitrogen, and carbohydrates being calculated as starch.

In certain localities there is a demand for a special flavored and spiced mustard, while in other sections of the country, the same mustard would not sell. Often it is the price that determines quality or the fact that the consumer desires a certain colored and flavored product. Certain communities demand a mustard which contains an appreciable amount of turmeric. Such a product has been considered an inferior article, as high grade mustard is made with yellow and brown seeds without the addition of turmeric.

The amount of spices, as well as vinegar and salt, will often vary according to whether the manufacturer wishes to produce a high grade product or simply a cheap one. He may also use spices as well as yellow mustard



Mustard mills, usually made of New York granite, consist of two disks, one stationary and one revolving at about one rpm.

in part for yellow and brown seeds. The price of the raw material will to a certain extent control the amount and kind of substitutes used. Some will even add starch or gums to give body, but if the product is properly made these are not necessary.

The mustard seed, spices, and other ingredients used should be ground or crushed before being weighed. The salt should be broken up so that no large lumps are dumped into the mixing tank, to fall to the bottom and break the agitators or throw off the belts. The seeds can be crushed by running through steel rolls or else by coarse grinding through a mill. Care must be exercised so that the seeds do not get overheated due to the fine set of the rolls or plates in the mill.

MUSTARD MILLS OR GRINDING STONES:—While the old Buhr stones of France were considered very good for grinding, granite stones from New Hampshire and New York are used more extensively in the mills of today, New York granite being used almost exclusively. One large firm that furnishes most of the mustard equipment uses the Esopus stone, which is quarried in New York state, as they find that gives the best results.

The mills consist of two flat stones, 30, 36, 42 or 48 inches in diameter and are set either in wooden or steel frames. Each stone has furrows twice as deep as the lines radiating from the center of the stone. They act as canals for the wet mustard to flow along and grind as the lines pass over each other, working the mustard to the skirt or outside of the mill where it then runs through the spout of the mill. The lower or bed stone is usually stationary and the upper one revolves around on a spindle from 60 to 80 revolutions per minute, being driven by a gear and pinion drive. The stones when newly dressed will grind the mustard very fine and smooth and have a greater capacity than when dull, but as they wear down the mustard becomes coarser. Freshly dressed stones will grind the mustard finer and produce a heavier body than stones that have been operated 4 to 5 weeks. Dull stones will give specks or coarse particles in the finished mustard and the stones set closely will produce a hot mustard due to the friction. Do not wait too long to re-dress the stones because mustard with "specks" or coarse particles will affect eventual sales. This necessitates careful watching to keep the mills supplied with materials constantly, otherwise, they are likely to heat up, pieces break off and wear down rapidly. The pump must be adjusted to increase the flow if necessary.

Stones should be carefully dressed by an experienced person, otherwise they are likely to be spoiled and re-

Caps being placed on mustard jars by hand before going to sealer. Screw caps are used almost exclusively for this product.

Labeling mustard. Mustard for the consumer trade is packed in 6 or 8 oz. jars so that quick usage will reduce discoloration.

cutting smooth again before re-dressing.

Raise or lower the stones slowly as necessity demands, thus obviating trouble of splitting or breaking.

There seems to be a difference of opinion regarding mustard coming from freshly dressed stones. The experience of some has been that it is likely to have a peculiar taste because of the stones, but if allowed to stand for several days, this taste will disappear. Others maintain that stone is tasteless, and will therefore not impart any taste whatsoever to the mustard.

The stones wear down about $\frac{1}{32}$ of an inch on a 4 foot mill in grinding 1800 gallons of mustard so the amount of stone or silica entering into the finished batch would be negligible.

SEEDS:—The two seeds used are the yellow, which is **Brassica (Sinapis) Alba**, and the black or brown, **Brassica Nigra**. The brown seed is higher in volatile oil, low in crude fiber, high in nitrogen, and is used in a larger proportion in many mixes. The English yellow or white is noted for exceptionally good flavor. The yellow seeds are the California, Montana, Dutch, Danish and Roumanian yellow, all of the yellow family.

One pound of English yellow seed is equal to 1⅛ pounds of any of the other seeds of the yellow family in giving body to the finished mustard and is stronger in volatile oil than any of the other yellow seed.

One pound of English yellow seed equals 3 pounds of Sicilian, California Trieste, German Trieste brown seed in producing the proper body or thickness to the product. Also one pound of this seed equals 2 pounds of Bombay seed in making the proper body.

Some prefer to blend the seed about 60% brown and 40% yellow; others, about 90% brown and 10% yellow. Each manufacturer blends according to flavor desired or cost.

Sicilian, California, Bombay, English, German or German Trieste brown seed are the principal ones used in wet mustard milling. These seeds are of the Sicilian brown or Trieste family. The brown seed are used because of the high percent of volatile oil and especially the Sicilian brown which sometimes is higher in volatile oil than the English.

U. S. P. STANDARD FOR BLACK MUSTARD SEED:—The ripe seed (**Brassica Nigra**), containing not more than 5% of foreign matter, yields allyl isothocyanate on distillation. Ash not more than nine per cent.

U. S. P. STANDARD FOR WHITE SEED:—The ripe seed of **Sinapis Alba** contains not more than 5% foreign matter and the ash not over 9%. It does not yield allyl isothocyanate on distillation with steam.

Analysis of both the brown and white seed shows that they contain from 27-38% fixed oil, soluble ferment—myrosin and sulfocyanate of sinapin, no starch and very little true volatile oil as such. The black mustard contains sinigrin, which hydrolizes when moistened with water and forms the volatile oil of black mustard, which is known as allyl isothocyanate.

This volatile oil is a colorless liquid with a very powerful pungent odor, and will redden and blister the skin when brought in contact with it. Has a specific gravity of 1.016 to 1.030; it boils between 148 and 156° C.; is optically inactive.

The fixed oil of mustard is a bland, tasteless, and odorless oil with a specific gravity of 0.914 to 0.918.

The brown and yellow seeds are used mostly in the manufacturing of prepared mustards, although they may be named for a particular locality where the seed was originally imported or grown. The California brown seed is called California Trieste, being grown from imported Trieste seed of Italy.

The yellow seeds were imported from England, Holland, Germany, Austria, China, and Japan. The English yellow seed is considered very finely flavored. Seed production has become an extensive industry in California. The seeds from this locality are very good, being free from foreign matter and other seeds.

DIRTY SEEDS:—Only clean seeds free from mold, excessive amounts of foreign seed and rat and mice "droppings" should be used. Moldy seeds can be washed to remove visible mold and may be given a thin coating of a bland neutral oil to give them the appearance of high grade seed. Once moldy always moldy, and this can be easily determined by placing some seed in a closed glass jar, covering with hot

water and allowing them to stand for several minutes and then smelling. Moldy and poor seeds are easily detected and removed.

Some brown seeds seem to impart a peculiar bitter flavor to the freshly ground product, but upon standing, this disappears and the flavor is not impaired.

BRAN:—Brans are the outer shell or coating of mustard seed after the flour has been removed. One pound of English yellow bran is equal to 1⅔ pounds of English yellow seed in giving body to the mustard and one pound of English yellow is equivalent to 2 pounds of Dutch, Danish, California, Roumanian and Montana yellow seed. Also one pound of English yellow bran is equivalent to 4 pounds of Japanese, Manchurian or Chinese seed. Some use brown bran but it is rarely used because as a thickener or body maker it is worthless.

CHARLOCK SEED:—One of the adulterants of mustard is charlock or wild mustard, which can be easily detected by using a small hand lens or a simple chemical test. When examined with a lens, mustard seeds are rough and striated, while charlock is perfectly smooth.

In applying the chemical test, place a very small amount of the crushed seed on a glass slide or saucer and add several drops of a solution of chloral hydrate (16 grams chloral hydrate, 1 c.c. hydrochloric acid and 10 c.c. of water). Heat gently and then examine with a lower power hand lens; if charlock is present, a bright red color appears.

To determine the amount of foreign seed present, it is necessary either to weigh and count the foreign seed present or else count 100 or 200 seeds and determine the number of foreign seed in the sample. A hand lens will aid materially in making the count.

CHINESE AND JAPANESE YELLOW SEED:—Sinapis (Brassica) Cernua:—These are yellow varieties of the black or brown seed, yield a fair proportion of volatile oil and when clean and ripe are legally allowed to be used. They are not the same seed as English or German yellow seed.

The Japanese yellow, Manchurian yellow, Russian yellow, and Chinese yellow seed do not contain as much volatile oil as the other yellow seed of the English yellow family, nor do they have the same thickening property. One pound of English yellow is equal to three pounds of the above mentioned Eastern seed when used in wet mustard and are considered very poor to give body to the finished product.

MIXING:—Before starting to grind a batch, the ingredients must be thoroughly mixed. If possible the mix is made the day previous to grinding and allowed to stand over night in a covered tank, or for at least five hours to liberate the volatile oil and produce a hotter product.

The mixing tank is equipped with paddles or arms attached to a shaft which keeps the batch constantly agitated. Two of these paddles are at the bottom of the tank to prevent the material from caking there.

The vinegar is first run into the tank, then the crushed mustard seed may be added; follow this with the addition of spices and salt. Above all the things see that the batch is thoroughly mixed before trying to run it through the pumps.

VINEGAR:—White distilled vinegar is the one most used, but cider, malt, and spiced vinegars are often substituted. The acidity of the finished goods may be regulated according to the season. In summer the acidity is kept at about 4% or 40-"grain" and in the winter is often cut to 3.5% or 35-"grain." 40-"grain" vinegar is a good all-year strength to be used. Any lower acidity has a tendency to permit fermentation and any higher than 4.5% is too sour. Of course, the [illegible] can be easily overcome by the proper [illegible] certain ingredients such as sugar and salt. Vinegars, other than distilled, are usually too expensive for [illegible], even though some believe they obtain a better [illegible] from the mixed

vinegar which gives a fine flavor. The following is a good spiced vinegar:

SPICED VINEGAR

Thyme	3 pounds
Marjoram	3 pounds
Celery Seed	3 pounds

Steep the herbs and seeds in 48 gallons of 100-"grain" vinegar, keep well covered and use 2 gallons per 180-gallon batch of finished mustard.

SPICING:—Besides mustard seeds, ground cinnamon, clove, all-spice, red pepper, nutmeg, celery seed, white and black pepper, and turmeric are used. Garlic improves the taste wonderfully. It seems to give the product a certain smoothness and flavor that would otherwise be lacking. Some are inclined to criticize its use, as they claim it will cause fermentation and spoilage, but it can be used without fear of spoilage. Spoilage may be caused by insufficient salt, vinegar, or by using seed that is contaminated. The matter of spoilage will be treated under "fermentation in mustard."

Garlic vinegar is made by adding to a half barrel of ground or chopped garlic an equal amount of 100-"grain" vinegar. Mix well and allow it to stand about a week to leach. Draw off one gallon of the garlic vinegar (the product will separate), and add it to a batch of mix that will finish about 180 gallons. Each time a gallon of garlic vinegar is drawn off, replace it with a like amount of 100-"grain" vinegar and when the strength seems to weaken, add the ground garlic to the mix. Garlic when used in small amounts will produce an appetizing flavor that cannot be produced by general spicing.

Turmeric is used in most of the cheaper grades, more for color than flavor, although it has some spice value. Regarding the use of turmeric in mustard, there seems to be a difference of opinion as to its spice merits, some think it has none whatsoever, but if a batch is made with and without the addition of turmeric, a marked difference in the flavor of the finished product will be noted.

FERMENTATION IN MUSTARD:—There has been considerable fermentation in prepared mustard, due to bacterial contamination. Some thought it was due to unripe seed that produced an enzyme, thus assisting the bacteria to act readily. However, this fermentation has occurred where seed over a year old has been used.

The bacteria causing the fermentation are found in the soil, and it is usually caused by **B. Mesentericus** and **B. Vulgaris**, or **B. Vulgatus.** The fermentation is caused by a long, rod-shaped diplobacillius, quite often joined together at right angles, and easily recognized under the microscope. It develops in mustard with an acidity of less than 3.5% and sometimes as high as 4%. The activity of this organism can be destroyed by heating or pasteurizing the product after being manufactured. Still better, the seed may be pasteurized by dry heat at about 160-170° F. as this temperature will not destroy the activity of the seed.

It has been found that garlic will prevent fermentation in mustard.

In the formation of the volatile oil of mustard, glucose is also one of the products formed. As glucose is an easily fermented sugar, fermentation may set in unless the various ingredients are in the proper proportion to prevent spoilage.

It is claimed by old mustard grinders that one to two ounces of tartaric acid per barrel of finished mustard will prevent fermentation.

GENERAL POINTS:— In operating the mills, the temperature of the finished product should not exceed 70-80° C. (155-176° F.) Should the temperature exceed 80° C., then the stones are getting worn down and need recutting, or they are set too close and are grinding too fine. High temperatures cause the loss of volatile oil, flavor, and separation. Sepa-

ration is also caused by lack of solids in the finished product.

The vinegar acidity in the finished products should never be less than 3.5% acetic, preferably 4%. Some use 3.5% in winter and increase it to 4% in the summer.

In trying the mustard for body if it should run off the paddle, it is too thin. It should fall off the end of the paddle in drops about the size of chocolate drops.

The characteristic flavor of the finished mustard changes after standing for 24 to 30 hours, no doubt due to the action of the vinegar and spices blending or mellowing with the seed.

Finished mustard can be filled immediately from the mills into glass containers, pails, or barrels.

If it is desirable to sterilize mustard use the following:

STERILIZING MUSTARD

6-ounce glass	for 30 min. at 150° F.
7 and 8-ounce glass	for 40 min. at 150° F.
16-ounce glass	for 30 min. at 180° F.
32-ounce glass	for 60 min. at 180° F.

The containers (especially where barrels are used) should be filled as full as possible to exclude air; otherwise the product is likely to turn black on top. This darkness through time may penetrate for some distance.

Iron pipes and iron in any form should be carefully avoided throughout the equipment, as iron will cause discoloration. Wooden or hard rubber pipes should be used. The use of brass or copper pipes may cause a metallic taste due to the action of the vinegar dissolving copper and zinc.

It will require at least two grindings to finish the product to the proper smoothness. One roughing stone will have a capacity that can take care of two finishing mills. Fine grinding produces a better flavored product, but the stones have to be set so close that they heat, causing loss of volatile oil and requiring recutting very soon.

In cutting the stones, 12 fields run cooler than 8 and should be cut with plenty of draught at the tangents. The lines should be cut ¼ to ⅜ inch. The ¼-inch grinds finer, but wears faster. The stones should be dressed by an experienced person. Should there be any doubt as to dressing, then consult the manufacturer as to laying out before redressing.

The equipment necessary for making prepared mustard is not so extensive or expensive when one considers the volume of finished material and the life of the equipment. The equipment usually consists of a mixing tank, mills, pumps, receiving tanks, shafting, motive power, and filling device.

FORMULAS:—It is rather difficult to give formulas that will be workable the year round, as there is considerable variation in the quality of the various seeds, spices, bran, tailing, etc. Some brans have greater thickening properties than others and, of course, less would be required to give the proper results. Seeds also vary greatly as to quality. The formulas given may be varied to suit the needs of the manufacturer, or may be used as a basis for modifying their own. There is no hard and fast rule nor set formulas unless working from large stock of raw materials and once the formula is established, it should be kept as nearly the same as possible. 1 pound of bran will take up 1¾ gallons of vinegar and 1 pound of seed, 1 gallon vinegar.

Corn meal, or corn starch may be substituted for mustard bran in the cheaper grades, but must be so labeled.

ANALYSIS—PREPARED MUSTARD

Moisture	75.37%
Total solids	24.63%
Total acidity (as acetic)	3.50%
Dry Basis—	
Salt	4.88%
Fat	3.61%
Protein	45.60%
Carbohydrates as starch	26.70%
Crude fiber	5.28%

The composition of black and white seed as given by Piesse and Stansel (Analyst 1880, 163) is as follows:

	White	Black
Water	8.00%	8.52%
Non-volatile oil	27.51%	25.54%
Volatile oil	0.08%	0.47%
Cellulose	8.87%	9.01%
Albuminoids	28.06%	26.50%
Myrosin and Albumin	4.58%	6.46%
Soluble matter	26.29%	24.22%
Ash	4.70%	4.98%

COMPOUND MUSTARD (IMITATION)—NO. 4

Brown seed	60 pounds
Brown bran	30 pounds
Yellow seed	20 pounds
Yellow tailings	20 pounds
Yellow bran	25 pounds
Salt	50 pounds
White pepper	1 pound
Black pepper	1 pound
Red pepper	1 pound
Cinnamon, ground	12 ounces
Clove, ground	12 ounces
Allspice, ground	12 ounces
Capsicum	2 ounces
Curry, powder	8 ounces
White vinegar, 40 "grain"	160 gallons

Yield 170 gallons

MUSTARD FORMULAS

	No. 1	No. 2	No. 3
White distilled vinegar 40 "grain"	400 gallons	400 gal. (30 gr.)	400 gal. (30 gr.)
Brown seed	600 pounds	500 Bombay	450 pounds
English seed	200 pounds	200 pounds	195 pounds
Salt	150 pounds	150 pounds	150 pounds
Garlic vinegar (1/1 in 100 gr. white vinegar)	½ gallon	½ lbs. ground	1 pound
Black pepper	3 pounds	3 pounds	
White pepper	3 pounds	3 pounds	
Celery seed	2 pounds		
Clove	2 pounds	3 pounds	4 pounds
Cinnamon	2 pounds	3 pounds	4 pounds
Cayenne	1 lb. Red pepper	5 pounds	5 pounds
Nutmeg	1½ pounds	1½ pounds	
Paprika	4 pounds		
Produced	515 gallons	440 gallons	

Some prefer to use red pepper rather than cayenne, but a larger amount is necessary.

FRENCH STYLE—NO. 5

White distilled vinegar, 40 "grain"	500 gallons
Japanese yellow seed	350 pounds
English yellow seed	250 pounds
Turmeric	24 pounds
Cayenne	12 pounds
Salt	165 pounds
Cloves—powdered	8 pounds
Allspice	4 pounds

Produced 550 gallons

DUTCH STYLE—NO. 6

White distilled vinegar, 40 "grain"	400 gallons
California yellow seed	270 pounds
Japanese yellow seed	200 pounds
English yellow seed	175 pounds
Salt	125 pounds
Cayenne	5 pounds
Cloves	8 pounds
Allspice	5 pounds
Turmeric	16 pounds
Horseradish root*	8 pounds

* After cleaning, coarsely grind the roots through a food grinder so particles will show in the mustard.

DUSSELDORF STYLE—NO. 7

White distilled vinegar, 40 "grain"	400 gallons
California or Sicilian brown seed	455 pounds
English yellow seed	195 pounds
Salt	128 pounds
Cloves	6 pounds
Garlic	1 pound
Cayenne pepper	5½ pounds

Grind fine so no "specks" show.

HAMBURG STYLE—NO. 8

White distilled vinegar, 40 "grain"	200 gallons
English yellow seed	67½ pounds
Sicilian brown seed	12½ pounds
Yellow mustard cake	112½ pounds
Salt	50 pounds
Allspice	1½ pounds
Cayenne	1½ pounds
Caramel color	16 ounces

Grind fine so no "specks" show.

PAPRIKA STYLE—NO. 9

White distilled vinegar, 40 "grain"	375 gallons
English yellow seed	450 pounds
Salt	130 pounds
Cinnamon	6 pounds
Turmeric	10 pounds
Paprika sauce*	25 gallons

Yield 412½ gallons

* Paprika sauce used 18 ozs. paprika per 1 gallon of 40 "grain" vinegar.

TOBASCO MUSTARD—NO. 10

White distilled vinegar, 40 "grain"	400 gallons
Sicilian brown seed	600 pounds
English yellow seed	100 pounds
Salt	120 pounds
Cinnamon	10 pounds
Tobasco peppers	12 pounds

Produced 440 gallons

This is a very hot pepper used greatly in the South.

BELGIAN OR GERMAN STYLE—NO. 11

White distilled vinegar, 40 "grain"	400 gallons
Sicilian brown seed	600 pounds
English yellow seed	100 pounds
Salt	120 pounds
Cloves—powdered	4 pounds
Cinnamon powdered	3 pounds
Cayenne powdered	4 pounds

Produced 440 gallons

Grind fine.

HORSERADISH STYLE—NO. 12

White distilled vinegar, 40 "grain"	400 gallons
California or Sicilian brown seed	270 pounds
Japanese or Manchurian seed	200 pounds
English yellow seed	175 pounds
Salt	125 pounds
Cayenne	5 pounds
Clove	8 pounds
Allspice	5 pounds
Horseradish root*	8 pounds

* Grind coarsely through food grinder so particles will show in the mustard.

SPICED MUSTARD DRESSING—NO. 13

White distilled vinegar, 40 "grain"	500 gallons
Japanese yellow seed	180 pounds
Danish yellow seed	60 pounds
Yellow tailings	90 pounds
English yellow bran	155 pounds
Salt	175 pounds
Cayenne	12 pounds
Cloves	6 pounds
Allspice	4 pounds
Turmeric	25 pounds

Produced 550 gallons

SALAD STYLE MUSTARD—NO. 14

White distilled vinegar, 40 "grain"	500 gallons
English yellow seed	355 pounds
Manchurian seed	100 pounds
Japanese seed	60 pounds
Salt	65 pounds
Sugar	33 pounds
Turmeric	33 pounds
Paprika	6 pounds
Salad oil	3 gallons
Oil of cloves	5 ounces
Oil of cassia	2 ounces

Produced 550 gallons

Grind fine.

COMPOUND MUSTARD (IMITATION)—NO. 15

White distilled vinegar, 40 "grain"	160 gallons
Yellow bran	60 pounds
Brown bran	20 pounds
Yellow seed	20 pounds
Yellow tailings	20 pounds
Brown seed	20 pounds
Salt	50 pounds
Turmeric	4 pounds
Cayenne pepper	1 pound
White pepper	14 ounces
Black pepper	14 ounces
Clove—ground	12 ounces
Nutmeg ground	4 ounces
Curry powder	12 ounces
Cinnamon powder	12 ounces
Ginger powder	12 ounces
Spiced vinegar	10 gallons

Produced 180 gallons

YELLOW MUSTARD—NO. 16

Powdered turmeric	16 pounds
English yellow seed	40 pounds
California yellow seed	158 pounds
Salt	80 pounds

Salt	65 pounds
White distilled vinegar, 100 "grain"	68 gallons
Cayenne pepper	20 ounces
Black pepper	20 ounces
Nutmeg	12 ounces
Powdered cloves	1 pound
Powdered cinnamon	1 pound

Water in mix tank to 217 gallons.

MUSTARD WITH BRAN & TURMERIC

White distilled vinegar, 40 "grain"	160 gallons
English yellow seed	120 pounds
Yellow bran	70 pounds
Turmeric	7½ pounds
Salt	80 pounds
Spiced vinegar—see spiced vinegar	2 gallons
Ground cinnamon	12 ounces
White pepper	12 ounces
Allspice	12 ounces
Nutmeg	12 ounces
Cayenne pepper	8 ounces

Produced about 200 gallons

CHOW SAUCES—NO. 1

White distilled vinegar, 40 "grain"	145 gallons
Yellow seed	90 pounds
Brown seed	20 pounds
Salt	24 pounds
Turmeric	5 pounds
Garlic	6 ounces
Tragacanth	4 pounds
Cinnamon, powdered	24 ounces
Clove, powdered	6 ounces
Ginger, powdered	6 ounces
Nutmeg	4 ounces
Cayenne pepper	16 ounces
Black pepper	12 ounces
White pepper	6 ounces

Produced 180 gallons.

Soak the tragacanth over night before using. Arrowroot starch may be substituted for gum. The West Indian starch gives better results than domestic. This sauce is added to cut pickles to make chow-chow.

CHOW SAUCES—NO. 2

White distilled vinegar, 40 "grain"	83 gallons
Sicilian brown seed	19 pounds
English yellow seed	45 pounds
Cloves	6 ounces
Cayenne	42 ounces
Turmeric	13 pounds
Oil of mustard	1½ ounces
Table sauce	5 gallons
Curry powder	20 ounces
Gum Asafetida	2½ ounces
Salt	80 pounds

Grind very fine through mustard mill.

MUSTARD DRESSING

	A	B	C
Yellow seed	100 pounds	60 pounds	14 pounds
Yellow bran	20 pounds	40 pounds	10 pounds
Salt	50 pounds	50 pounds	16 pounds
Turmeric	4 pounds	5 pounds	5 ounces
Ground cinnamon	12 ounces	8 ounces	
Ground cayenne	12 ounces	12 ounces	
Ground cloves	12 ounces	8 ounces	
Ground nutmeg	8 ounces	8 ounces	
Gum tragacanth	4 pounds	4 pounds	
30 "grain" white vinegar	135 gallons	135 gallons	
Paprika	1 ounce		
Powdered ginger	1 ounce		
Powdered licorice	3 ounces		
White pepper	2 ounces		
100 "grain" white vinegar	14 gallons		
Water	28 gallons		
Salad oil	3 gallons		
Starch	10 pounds		
Sugar	28 pounds		

Produced 140 gallons

Mix the starch in a little water, cook to a smooth paste, and add it to the other ingredients in a mixing tank; grind through the mills twice.

Soak the tragacanth in water over night and add to the batch and grind twice. Some mix the gum with the dry spices and grind without soaking. Label as containing added bran.

Horse Radish

As this product is not stable, it should only be prepared for immediate consumption. The roots are washed in a tumbler or rotary washer to remove the soil clinging to them. Then scraped to remove the brown outer skin, or they can be cleaned in an automatic vegetable peeler.

When clean, the roots are either ground through a food chopper or in a horse radish grater.

Cover the grated material with a vinegar prepared by mixing 100 gallons of 40 "grain" vinegar with 20 pounds of salt. Fill into bottle immediately and cap. Usually screw caps that reseal are used.

HORSE RADISH MUSTARD:—This product can be made by mixing 1 gallon of finely grated horse radish with 15 gallons of finished mustard. This amount of horse radish may be varied, depending upon how strong a product is desired. The mix may be varied to 10 gallons of mustard and 5 gallons of horse radish. This product, like horse radish is not stable and should only be made in small amounts for local consumption. The waste trimmings from the roots are often used in preparing this product.

Horse radish mustard can be made by using high grade mustard to which 20 to 25 pounds of bran has been added per 250 gallons of mustard and then add 25 gallons of prepared horse radish seasoned in salt and vinegar. Add the mustard seed, spices and horse radish, etc., in the first mixing tank and grind coarsely through the mill. Collect in barrels and fill into containers.

CURRY POWDER:—This preparation is used greatly in the eastern hemisphere as a condiment. The following are formulae:

INDIAN CURRY POWDER—NO. 1

Coriander seed	5 pounds
Turmeric	5 pounds
Cardamon	40 pounds
Cayenne pepper	10 pounds
Fenugreek seed	40 pounds

Mix all of the spices together and place in a warm oven (not hot) or over warm pipes for about 12 hours to drive off excess moisture and then grind very fine. It can then be packed in spice cans for the trade.

CURRY POWDER—NO. 2

Coriander seed	16 pounds
White pepper	1 pound
Cayenne pepper	½ pound
Turmeric	1½ pounds
Ginger	1 pound
Mace	½ pound
Clove	½ pound

Fennel	½ pound
Celery seed	½ pound
Cardamon	½ pound
Slippery elm—powdered	4 pounds

Mix all of the ingredients well before using.

CURRY POWDER—NO. 3

Coriander seed	70 pounds
Salt	12 pounds
Yellow mustard seed	8 pounds
Capsicum	8 pounds
Turmeric	8 pounds
Black pepper	4 pounds
Broken cassia	4 pounds
Allspice	4 pounds
Bombay mace	1 pound
Celery seed	1 pound
Fenugreek seed	1 pound
Cumin seed	1 pound

Grind and mix to a fine powder, or use powdered ingredients and mix for at least one-half hour in a power mixer.

Sauces

SOYA SAUCE—CHAING YOO—SAUCE OIL:—Method 1:—Sound yellow soya beans are cooked (boiled) until they are soft, then mixed with flour while they are wet and warm. Sieve to remove the surplus flour. Now place the beans on trays of matting, wood, or bamboo, and place in a warm room and cover with matting for about three days. At the expiration of that time a white mold should cover the beans, but if a black mold has developed the beans must be destroyed and a fresh start made, as the proper organism is not present.

Place the moldy beans in large jars (about three-quarters full), cover with a 25° salt brine. After standing for several days, stir for several minutes each morning and evening during the entire summer. Cover the tops of the jars to keep out the rain and direct sunlight. When the product has the proper odor and flavor, remove from the crocks and press to obtain the sauce.

May and June seem to be the best time to make the finest quality sauce. To make an extra high quality, mix quantities of old sauce with the brine of the new, as this inoculates the new and assures the proper fermentation and flavor.

The sauce is stored in sealed stone jugs and keeps almost indefinitely.

Should the summers be long and very hot, a 30° brine is used, and if the mold does not appear within the three days, the beans are allowed to remain several days longer. To improve the flavor, the moldy beans may be placed in the sun for one day before covering with the salt brine.

Method 2:—Soya beans soaked over night—1 gallon. Cook until soft, drain well, and add 1 gallon of bruised wheat. Let this mixture stand in a warm place for 24 hours and add 1 gallon of common salt, 2 gallons of water. Place in a tightly covered stone jar for 2 to 3 months. Mix occasionally. When a good soya has developed, press out the liquor and use.

Roasted wheat may be substituted for the plain to obtain a better flavor, and the beans may be inoculated with **Aspergillus Orizae** or some old soya sauce to aid in the development of the desired flavor.

IMITATION SOYA SAUCE:—Mix 18 gallons of black molasses (West Indian), 4½ pounds of salt, 2½ pounds of extract of licorice. Place the licorice in 2 gallons of water and heat until it softens, then add it to the salt and molasses, and mix together until dissolved.

BEET RELISH:—Cook the beets until tender, soak in 40-grain vinegar for several days. Chop very fine (do not [illegible] beets that have had the excess liquid drained off, in the proportion of about three parts of beets and one of the horse radish. The proportions of the mixture can be varied to suit the taste because of the strength of the horse radish.

WORCESTERSHIRE OR WORCESTER SAUCE—A

White vinegar—40 "grain"	15 gallons
Walnut catsup	10 gallons
Mushroom catsup	10 gallons
Sherry wine	5 gallons
Raw cane sugar	25 pounds
Tamarinds	10 pounds
Salt	12 pounds
Canton soya sauce	4 gallons
Powdered cayenne pepper	2 pounds
Powdered allspice	1 pound
Powdered coriander	1 pound
Powdered clove	½ pound
Powdered mace	½ pound
Powdered asafoetida	¼ pound
Brandy	1 gallon
Hogs' livers	20 pounds

Cook the livers thoroughly for about 10 hours, grind very fine and add to the above. Instead of using the wine and brandy, special non-alcoholic flavors or extracts may be substituted.

WORCESTERSHIRE OR WORCESTER SAUCE—B

Canton soya	1 gallon
Walnut catsup	1 gallon
Salt	6 pounds
Cayenne pepper	3 pounds
Ground nutmeg	3 pounds
Ground clove	3 pounds
Ground ginger	3 pounds
Ground lemon peel	8 pounds
Garlic	8 ounces
Sugar	24 pounds
Vinegar, 40 "grain"	16 gallons

Place all of the ingredients in an iron kettle for three days, cook, and bottle hot. The product will turn black and have an astringent taste due to the action of the vinegar on the iron in the presence of tannin from the spices.

WORCESTERSHIRE OR WORCESTER SAUCE—C

Water	12 gallons
Vinegar, 90 "grain"	5½ gallons
Chinese soya	3½ gallons
Cayenne pepper	1½ pounds
Clove—ground	1¼ pounds
Ground nutmeg	1¼ pounds
Ground black pepper	1¼ pounds
Garlic	1¼ pounds
Salt	1⅞ pounds

ENGLISH BEEFSTEAK SAUCE

Malt vinegar (40 grain)	25 gallons
Mushroom catsup	5 gallons
Walnut catsup	5 gallons
Salt	10 pounds
Molasses	3 gallons
Powdered cayenne pepper	1½ pounds
Powdered allspice	¾ pound
Powdered coriander	¾ pound
Powdered clove	¼ pound
Powdered mace	¼ pound
Powdered asafoetida	¼ pound
Canton soya	1 gallon

Cook the ingredients together slowly for two hours, replacing the evaporation with water. Bottle hot, steeping for 30

minutes at 160° F.

WALNUT CATSUP (IMITATION)

White vinegar, 100 "grain"	2 gallons
Water	10 gallons
Soya sauce	3 gallons
Beef extract	5 pounds
Garlic powder	14 ounces
Onion powder	16 ounces
Table sauce	5 pounds
Walnut flavor (synthetic)	2 ounces

SAUCE EXTRACT—E

Grind 90 pounds of hogs' livers very fine and place in a barrel with 90 pounds of salt and 40 gallons of water. Allow this to stand about 30 days before using.

Cook the following ingredients slowly for one hour and then add the vinegar:

Soya sauce	12 gallons
Apple pulp	12 gallons
Garlic ground very fine	2 pounds
Lemon chopped	10 pounds
Salted hogs' livers	10 gallons
Sugar	40 pounds
Water	10 gallons
Vinegar, 80 "grain"	20 gallons

Then place in a barrel and add the vinegar and allow the mixture to stand for a week and strain through a 14-mesh sieve. Fill into a tight barrel and use as needed.

TABLE SAUCE—F

Vinegar (80 "grain")	50 gallons
Curry powder	5 pounds
Cayenne pepper	4 pounds
Soya sauce	4 gallons
Sugar	10 pounds
Salt	10 pounds
Boiled cider	4 gallons
Sauce extract	24 gallons
Walnut catsup	10 gallons

Place all of the ingredients with the exception of the vinegar into a kettle with 10 gallons of water. Cook slowly 20 minutes, add the vinegar, and mix thoroughly. Allow the sauce to stand several weeks before using.

BENGAL CHUTNEY OR RELISH

Brown sugar	20 pounds
Salt	10 pounds
Powdered mustard	10 pounds
Onions	10 pounds
Ground ginger	5 pounds
Cayenne pepper	5 ounces
Seeded raisins	10 pounds
Apples	60 pounds
Ripe tomatoes	30 pounds
Turmeric	1 pound
Vinegar, 40 "grain"	8 gallons

Place the mustard in a bag and boil in the vinegar. Cook the apples, tomatoes, spices to a pulp, and run through a finisher, using a coarse sieve. Chop the onions very fine and incorporate in the product. Fill hot and sterilize for 30 minutes at 180° F.

CALCUTTA SAUCE

Apples	5 pounds
Green tomatoes	5 pounds
Seeded raisins	5 pounds
Onions	2 pounds
Garlic	1½ pounds
Shallots	1½ pounds

Chop all fine and place in open headed barrel, and then add:

Salt	5 pounds
Brown sugar	5 pounds
Cayenne pepper	½ pound
Powdered ginger	1 pound
Vinegar, 40 "grain"	7 gallons
Lemon juice	3 gallons

Mix all ingredients thoroughly and let stand several weeks to age before bottling. Run through a catsup finisher, bottle and sterilize for 30 minutes at 180° F.

There are some special sauces such as Tartar, Russian, Thousand Island, Canadian Club, etc., which can be manufactured, but as a general rule, these sauces will not retain their original flavor on account of deterioration, consequently they should be made and sold in small quantities with no special guarantee as to stability. They are very good for delicatessen and specialty stores.

LOBSTER SAUCE:—A fine sauce can be made by mixing two parts of chili sauce, one of prepared horse radish, and then adding about ten per cent Worcester sauce. Bottle. This sauce, too, will lose strength on standing because of the horse radish deteriorating.

RUSSIAN DRESSING:—This relish can be made by mixing the following ingredients in a mayonnaise beater:

Grated carrots (raw)	1 gallon
Grated beets (raw)	1 gallon
Grated onions (raw)	1 gallon
Mayonnaise	6 gallons

This product is not stable and should be made fresh for local trade. If the product is to be kept, it should be pasteurized 30 minutes at 160° F. This is supposed to be the genuine Russian dressing. Some make a dressing by grinding 12 ounces of canned pimentos and mixing with one gallon of mayonnaise. If the raw materials are to be kept any time before being used, they should be covered with strong vinegar. Of course, this vinegar must be removed by pressing or draining before using the materials.

OLIVENAISE:—This can be made by chopping and mixing 1½ pounds of drained olives with one gallon of mayonnaise. A more characteristic olive flavor can be obtained by substituting olive brine in whole or in part for the water used in diluting the 100-grain vinegar in the mayonnaise, but omitting the salt in the formula.

THOUSAND ISLAND DRESSING

Formula A:—To one gallon of mayonnaise, add the following:

1 pound of chili sauce
½ pound of sweet pickle relish
½ pound of ground pimentos

Formula B:—To 5 gallons of mayonnaise, add 5 pints of chopped olives, 5 pints of ground sweet red peppers, 1 pound of finely ground walnuts, ½ gallon of chili sauce, and 1 pound of paprika. Mix all of the ingredients together, fill, cap and sterilize if desired for 30 minutes at 160° F. for half pints and 45 minutes at 160° for pints.

TARTAR SAUCE

To one gallon of mayonnaise add the following:

Chopped olives—very fine	5 ounces
Chopped pickles—very fine	5 ounces
Chopped capers—very fine	5 ounces
Chopped parsley—very fine	5 ounces

Chopped shallots or mild onions, 2 only. Mix well and fill and cap.

FRUIT SALAD DRESSING:—Heat together in a steam kettle or jacketed boiler one cup of each of the following: Pineapple, orange and lemon juices, with one cup of water. Mix 4 tablespoons of corn starch with 1 pound of sugar

and when the liquid begins to boil, add the sifted corn starch while stirring constantly to prevent lumping. Then cook slowly for 15 minutes, and pour over 8 beaten eggs and mix and again cook for one minute. This makes a very nice, sweet salad dressing to serve with fruit salads. It should be pasteurized for 30 minutes at 160°. It is quite different from mayonnaise and has a fine flavor.

CANADIAN CLUB DRESSING

Vinegar, 40 "grain"	43 ounces
Vegetable oil	86 ounces
White pepper	2 ounces
Lemon juice from	16 lemons
Chili sauce	1 gallon
Chopped onions—fine	1 pound
Red pepper—sweet—fine	5 ounces
Powdered mustard	2 ounces

Mix the oil, vinegar, mustard and pepper to make a French dressing, and when well mixed add the other ingredients. Should separation occur, the ingredients should be mixed well before using.

PEPPER SAUCE:—Small peppers, either red or green out of brine can be used to make a fancy pepper sauce. Fill the bottles with the peppers and cover with a solution composed of one part of filtered brine and three parts of 50-"grain" vinegar. If the sauce is to be made from dry peppers, use the small Japan Chillies, fill the bottle about half full, and cover with a 40-"grain" vinegar. Allow them to stand for several days to swell and absorb the liquid. Any seeds from the peppers can be ground and used in prepared mustard, as a substitute for part of the cayenne pepper.

TOBASCO SAUCE:—Is made by cooking tobasco peppers with the addition of salt and vinegar. The peppers are cooked until disintegrated in a tank with either coils or open steam pipe, then cycloned or sieved to remove the seeds and debris and this pulp is cooked with salt and vinegar. No sugar is necessary. It requires 20 pounds of salt and 20 gallons of 100-"grain" vinegar for 100-gallon batch. Take 100 gallons of the pulp and cook it down to 85 gallons then add the vinegar and cook from 3 to 5 minutes. Fill into bottles at 190° F. and then sterilize for safety. As this sauce is used principally in the South care should be taken to prevent spoilage.

WALNUT CATSUP:—Grind the green walnuts and then spread them out in the air and sun until they turn black. Place this pulp in a container and add 40 pounds of salt for each 50 gallons of walnuts. Cover with water and allow them to stand for two weeks.

In manufacturing the catsup, place 50 gallons of this pulp in a kettle with 40 gallons of 60-"grain"' vinegar, 40 pounds of sugar, 1 pound of onions, 6 ounces of garlic (both chopped), ½ pound each of ground cloves, mace, ginger, and black pepper. Cook (simmer) slowly for 2 hours, run through a catsup finisher and add water to make up the loss of evaporation. Bottle hot and sterilize for 30 minutes at 180° F.

English Style Walnut Catsup is made by grinding green walnuts to a pulp, pressing out the juice, and to each gallon of liquid adding 1 pound of anchovies, 1 pound of salt, 4 ounces of cayenne pepper, 2 ounces black pepper, 1 ounce powdered ginger, 1 ounce powdered clove, 1 ounce ground mace, and 1 ounce grated horse radish.

Boil all the ingredients to one-half their original volume [illegible] catsup finisher, fill into bottles while hot, [illegible] minutes at 180° F. The product should [illegible] stand for several months in order to age.

[illegible]UM CATSUP:—Place one peck of mushrooms in [illegible] cover with 2½ gallons of 40-"grain" vinegar [illegible] then add 1 ounce cayenne pepper, 1 ounce cinnamon, 1 ounce allspice, ¼ pound of salt, boil to a pulp and run through a catsup finisher. Bottle hot and sterilize for 30 minutes at 180° F.

CUMBERLAND SAUCE

Cider vinegar	30 gallons
Walnut catsup	12 gallons
Salt	12 pounds
Molasses	4 gallons
Caramel color	1 gallon
Powdered cayenne pepper	1¼ pounds
Ground allspice	2½ pounds
Ground cloves	½ pound
Asafoetida	¼ pound

Grind it with salt

LONDON CLUB SAUCE

Vinegar, 40 "grain"	30 gallons
Mushroom catsup	10 gallons
Salt	8 pounds
Molasses	3 pounds
Canton soya	2 pounds
Cayenne pepper	1¼ pounds
Pimento—powdered	½ pound
Coriander	½ pound
Clove	½ pound
Mace	¾ pound
Garlic—ground	2 pounds

Ice Box Mixes

This product is made in various flavors and packed in cans or glasses and used in conjunction with milk and cream to make ice cream to be frozen at home in electric refrigerators.

VANILLA

Sugar	49 pounds
Gelatine	1¼ pounds
Vanilla extract—pure	5 pounds (½ gal.)
Water	44¾ pounds or 5⅜ gallons
Produced	100 pounds

Mix the gelatine in cold water and heat slowly in a steam jacketed kettle until dissolved. Then add the vanilla extract, heat to about 160° F. Fill hot into cans or jars and sterilize at 180° F. for 30 minutes. Cool immediately.

CHOCOLATE

Sugar	48 pounds
Cocoa	20 pounds
Powdered gelatine—edible	1 pound
Salt	½ pound
Vanilla compound (see below)	4-4/5 ounces
Water	30 pounds
Produces	100 pounds
Vanilla compound is made as follows:	
Glycerine	32 ounces
Caramel	16 ounces
Alcohol	12¾ ounces
Coumarin	1¾ ounces
Vanillin	5 ounces

Mix the glycerine and caramel and add the vanillin and coumarin and heat until dissolved. Then cool and add the alcohol. If alcohol is not available, substitute glycerine for it. The caramel can also be omitted and glycerine substituted; this will make an almost colorless solution.

METHOD:—Mix the sugar and cocoa together. Dissolve the gelatine in the water by first mixing the gelatine in cold water and warming in a kettle or double boiler. Do not heat over a direct flame because it may burn. Do not boil but heat just enough to dissolve the gelatine and replace the water lost by heating. Add the gelatine to the [illegible]

sugar mix, or if the gelatine is in a jacketed kettle, slowly add the cocoa-mix and heat gently until dissolved and mix well, add the vanilla mix. Then fill hot into jars or cans and sterilize for 30 minutes at 180° F. and cool immediately.

STRAWBERRY

Cold pack berries (5 fruit + 1 sugar) coarsely chopped	72 pounds
Sugar	19 pounds
Gelatine — powdered — edible	1¼ pounds
Water	7½ pounds
Liquid red color	1 pint
Produced	100 pounds
Red color is made as follows:	
Powdered Amaranth	2¼ ounces
Poncean 3 R	1 ounce
Water to make	1 gallon

PROCEDURE:—Mix the gelatine with a portion of the water. Add the balance of the water and heat gently in a steam jacketed kettle or double boiler until the gelatine is dissolved. Then add the sugar and strawberries and heat slowly until dissolved. Add the color, which may at times require more or less, due to the color of the fruit. Any evaporation loss should be replaced.

This product contained approximately 30% fruit so if fresh berries are used, the above formula must be changed, or if any other cold pack berries are used. Fill hot into cans or jars and sterilize for 30 minutes at 180° F. and cool immediately.

GENERAL DIRECTIONS FOR USE:—This applies to all three flavors. To 11 ounces of any of the above mixes use the same quantity of milk and mix. Whip very stiff 1 pint of chilled heavy cream and mix it with the above fruit-milk. Pour this into the ice box tray and freeze as low as possible. Stir occasionally to prevent formation of ice crystals.

Many other flavors can be made, such as orange, lemon, raspberry, maple, peach, etc.

TABLE I

Corrections of Alcohol Hydrometers Calibrated at 60° F, in Per Cent by Volume of Alcohol, When Used at Temperatures Above or Below 60° F

Observed alcohol content	To or from the observed per cent alcohol: Add			Subtract													
	57° F	58° F	59° F	61° F	62° F	63° F	64° F	65° F	66° F	67° F	68° F	69° F	70° F	72° F	74° F	76° F	78° F	80° F
per cent	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*
1	0.14	0.10	0.05	0.05	0.10	0.16	0.22	0.28	0.34	0.41	0.48	0.55	0.62	0.77	0.93	.....	.....	.....
2	.14	.10	.05	.05	.11	.17	.23	.29	0.35	0.42	0.48	0.56	0.63	0.78	0.94	1.10	1.28	1.46
3	.14	.10	.05	.06	.12	.18	.24	.30	0.36	0.43	0.50	0.57	0.64	0.80	0.96	1.13	1.31	1.50
4	.14	.10	.05	.06	.12	.19	.25	.32	0.38	0.45	0.52	0.59	0.67	0.83	1.00	1.17	1.35	1.54
5	.15	.10	.05	.07	.13	.20	.26	.33	0.40	0.47	0.54	0.62	0.70	0.86	1.03	1.21	1.40	1.60
6	.17	.11	.06	.07	.14	.20	.27	.34	0.42	0.50	0.57	0.66	0.74	0.90	1.09	1.27	1.46	1.66
7	.18	.12	.06	.07	.14	.21	.29	.36	0.44	0.52	0.60	0.68	0.77	0.94	1.13	1.32	1.52	1.73
8	.19	.13	.06	.08	.16	.23	.31	.39	0.47	0.55	0.64	0.73	0.81	0.99	1.18	1.38	1.59	1.80
9	.21	.14	.07	.08	.16	.24	.32	.41	0.50	0.58	0.67	0.76	0.86	1.04	1.25	1.46	1.67	1.89
10	.23	.16	.08	.08	.17	.25	.34	.43	0.52	0.61	0.71	0.80	0.90	1.10	1.32	1.54	1.76	1.99
11	.25	.16	.08	.09	.18	.27	.37	.46	0.56	0.65	0.75	0.85	0.96	1.16	1.39	1.61	1.84	2.09
12	.27	.18	.09	.10	.20	.29	.39	.49	0.59	0.70	0.80	0.91	1.02	1.23	1.46	1.70	1.94	2.20
13	.29	.19	.10	.10	.21	.31	.42	.52	0.63	0.74	0.85	0.97	1.08	1.31	1.55	1.80	2.05	2.31
14	.32	.21	.11	.11	.22	.32	.44	.55	0.66	0.78	0.91	1.02	1.14	1.39	1.65	1.91	2.17	2.44
15	.35	.23	.12	.12	.24	.35	.48	.60	0.71	0.84	0.97	1.10	1.23	1.50	1.76	2.03	2.30	2.58
16	.37	.24	.12	.13	.26	.38	.52	.65	0.77	0.90	1.03	1.17	1.31	1.60	1.88	2.16	2.44	2.72
17	.40	.26	.13	.14	.27	.41	.54	.68	0.82	0.96	1.10	1.25	1.40	1.70	1.99	2.28	2.58	2.87
18	.44	.29	.14	.14	.29	.44	.58	.73	0.88	1.03	1.18	1.33	1.49	1.80	2.10	2.41	2.72	3.02
19	.47	.32	.16	.15	.30	.46	.62	.78	0.94	1.10	1.26	1.42	1.58	1.90	2.22	2.54	2.86	3.17
20	.51	.34	.17	.16	.32	.49	.66	.82	0.98	1.15	1.33	1.48	1.65	2.00	2.32	2.65	2.98	3.33
21	.53	.35	.18	.17	.34	.51	.68	.85	1.02	1.20	1.38	1.54	1.72	2.06	2.41	2.76	3.10	3.45
22	.56	.38	.19	.17	.36	.53	.71	.90	1.07	1.25	1.44	1.61	1.78	2.13	2.48	2.84	3.20	3.56
23	.58	.40	.20	.18	.37	.55	.74	.92	1.11	1.30	1.49	1.66	1.84	2.20	2.56	2.93	3.30	3.67
24	0.60	0.40	0.20	0.18	0.38	0.56	0.77	0.96	1.16	1.35	1.54	1.72	1.91	2.27	2.65	3.03	3.40	3.78

Source of data:

United States Bureau of Internal Revenue. Regulations No. 7 relative to the production, fortification, and tax payments, etc., of wine. 188 p. United States Government Printing Office, Washington, D. C. 1937.

Section 6—Processing Meat and Poultry Products

Chapter I—Canning of Meats

CANNED Meat Industry in the United States really began to grow during World War I. A steady growth was maintained through out the depression and drought years of the 1930's. During World War II and the following years, industry and government agencies carried on extensive research which resulted in the expansion of the canned meat industry to a point where it is now of considerable significance. At present there are at least fifty varieties of canned meat on the grocer's shelves. In addition the Armed Forces are using ten or twelve items which either are too expensive for commercial use or are needed only for military use.

LOCATION OF CANNERIES:—Meat canning plants are usually located in or near meat packing centers. Some packing plants are located in areas of dense population, preferring to transport the raw material rather than their finished product. In recent years there has been a slight trend of moving the meat packing plants to the meat producing areas and transporting the processed product. Adequate refrigerated truck and rail transportation facilities must be available. In addition there must be (1) sufficient refrigeration facilities in the meat canning plant to handle raw material, (2) large amounts of fresh, pure water and (3) an adequate sewage disposal system.

REGULATORY AGENCIES:—Those plants which do not distribute their products in inter-state commerce should follow local and state regulations concerning sanitation, processing and labeling. In addition they must comply with the Federal Pure Food, Drug and Cosmetic Act. Those plants that sell their products in inter-state commerce, in addition to complying with the above regulations, must produce the product in a Federally inspected house and comply with the regulations governing meat inspection of the U. S. Department of Agriculture, additions of January 1947, all supplements to this addition and meat inspection memorandums from the Chief of the Meat Inspection Division, Bureau of Animal Industry, U. S. Department of Agriculture. Since all regulations are subject to change it will be necessary to consult those regulations cited in this paragraph to determine what standards of performance are necessary at any given time.

Material used by meat canners is purchased according to sample or specified grades. The grades may be government grades or those in common usage by individuals of this specific industry, and in some instances, by Board of Trade regulations. Meats used in canned products are usually purchased according to Government grades or packer grades. Sometimes trimmings are purchased according to Board of Trade Regulation.

FREEZING FOR STORAGE:—In so far as possible meat canning is usually done during the period of greatest production of beef of the grade of cattle suitable for canning. However, canning operations are usually not of sufficient [illegible] of this grade beef. Beef as well as pork is [illegible] rest of the year by freezing and storing [illegible] of time. Frozen pork should not be used if [illegible] period longer than six months. Frozen beef can [illegible] one year after freezing.

To obtain the best quality canned product, frozen meat should be partially defrosted before being chopped or ground. If possible the de-frosting should be done below 45° F. If it is necessary to go to higher temperatures the large chunks should be cut into smaller pieces so that defrosting will be completed within three hours. Repeated freezing and defrosting is highly undesirable.

VEGETABLES used in canned meats are either in a dry form or a stored form. For example: lima beans, navy beans and peas are in a dried form; onions, carrots and potatoes are in a stored form. Corn may be supplied in brine (barrel) or canned form. Tomato puree is usually supplied in cans. The use of frozen vegetables is becoming more popular. Corn, carrots and sweet bell peppers are examples. This material is usually supplied by sample or government grades.

SPICES are usually procured by samples. They may be purchased as individual spices and blended by the meat canner or as is more frequently the case, a spice blend for a given product may be obtained from the spice manufacturer. Although it is not necessary, it is desirable to use thermophilic free spices.

MONOSODIUM GLUTAMATE AND HYDROLYZED PROTEIN: These products have recently been approved by the Bureau of Animal Industry, U. S. Department of Agriculture. These products are universally applicable to all types of meat products. They are a valuable blender of various spices and herbs used in flavoring the meat product, and enhance the effect of the seasoning compound.

Monosodium glutamate manufacturers recommend 2 to 3 ounces of monosodium glutamate to 100 pounds of the finished product for sausages, bolognies, frankfurters, meat loaf, luncheon meats and similar types of products. The recommended amount for canned beef stew, corned beef, meat balls and similar canned products is 0.15% of monosodium glutamate. This represents the addition of about 2 and ¼ ounces per 100 pounds of the finished product.

Cereal products such as flour, spaghetti and noodles are either procured according to manufacturer's grade or sample. It is imperative that well milled wheat flour be used in preparing gravies for canned meats.

All material must be handled as rapidly as possible when received by the plant and correct storage provided. If fresh meats are allowed to stand in a warm room or cereal products in a wet, steamy room, inferior canned meat products will always result.

PREPARATION:—Special preparation of raw materials is applicable to all canned meat products. Any specialized procedures will be discussed under each product.

BONING AND TRIMMING:—Meat for canning is completely boned, careful attention being paid to the removal of bone splinters that are apt to be present. Since the canner grades of beef come mainly from older animals they have a larger percentage of fibrous, tough connective tissue. Particular attention must be given to trimming the tough connective tissue before grinding. Canning beef, and frequently pork is trimmed to contain not more than 10% trimable fat. The trade generally interprets the trimable [illegible] to mean surface fat and such seam fat as may be [illegible]

readily with a knife. All bruises, glands, blood clots, tendons, excess fat and tissue that will not dissolve in cooking should be carefully trimmed off.

CUTTING:—Cutting is usually a hand operation and is used when large chunks of meat are desired in the finished product. Sometimes part of the cutting operation is done by machine. However the final cutting should be done by hand if the finished product is to avoid a stringy appearance.

GRINDING:—This is the most common operation for canned meats. The meat can be ground through a plate having holes varying from ⅛ to 1½ inch in size. The larger size plate is usually used for stew or hash products.

CHOPPING:—Chopping is done on a machine which consists of a large power driven revolving pan into which the meat is dumped and the blades so arranged that as the pan turns around the cutting knives chop the meat into fine particles. This process is suitable only for finely chopped products.

PARBOILING:—This is the process of partially cooking meat to which some water has been added. It is usually done in a large steam jacketed kettle made of aluminum or stainless steel. Parboiling accomplishes the following:

1. Shrinks the meat by removing an excessive amount of liquid which would give the product a sloppy appearance.
2. Aids in fixing the color in canned cured meat products.
3. Aids in the removal of bones and connective tissue.
4. It kills some of the vegetative forms of bacteria.
5. Elevates the temperature of the product which in turn helps to obtain a better vacuum in the can.

BRAISING:—This differs from parboiling in that it is a pre-cooking operation that is carried out either without the addition of moisture or the addition of a very slight amount to prevent burning. It is performed by cooking the meat in its own juices.

CURING:—A method of color fixation by using salt, sodium nitrate and/or sodium nitrite and sometimes sugar. There are three general methods used for canned meat products:

1. Soak the meat for 3 or 4 weeks as is done for uncanned meat products.

2. Soaking the meat during the cooking operation in a hot curing solution. The color of the meat is usually fixed in 15 to 20 minutes, depending on temperature, size of pieces of meat and the proportion of the ingredients of the curing solution.

3. Adding the curing ingredients to the cooked meat after it has been ground and placed in a mechanical mixer. Color fixation takes place during the mixing and subsequent filling and sealing operations. After a high temperature for processing has been reached the color fixation reaction stops.

PREPARATION OF VEGETABLES:—All vegetables should be thoroughly scrubbed before being used. When beans are used in the canned products, they should be soaked in clean, cold water before they are mixed with the other ingredients. It is also necessary to sort out any broken, discolored or split beans. This may be done by hand or by an electric eye device which is becoming commonplace.

Blanching is accomplished by exposing the vegetables to hot water or steam from 1 to 30 minutes, the time depending on the type of product desired. Water blanching is more common than steam blanching. Whetner water or steam is used in the blanching operation it must be carefully controlled as to temperature. Blanching removes the raw, sometimes bitter taste of the vegetable and inactivates the enzymes that might change the product unfavorably. When potatoes are lye peeled it is not necessary to blanch them as this operation blanches them sufficiently.

Peeling is an important preparatory process and must be done carefully. The most common methods used are hand, friction, lye and fire peeling. Other methods are scalding, saturated brine solution and high pressure steam.

CUTTING is the general term used to describe the dicing, cubing, slicing or other division of vegetables into smaller pieces. Most canned meat products usually contain fairly large pieces of vegetables that have been hand cut or machine diced. Small pieces are undesirable because they will disintegrate during the long processing required for canned meats.

Holding such vegetables as potatoes under water after peeling is necessary to prevent discoloration of the raw surface. When governmental regulations permit the addition of sulfite to the potatoes, either directly or in the holding water, it will greatly aid in preventing discoloration. Although it is not necessary to hold carrots under water, it may be advisable where the time of preparation and the final use extend over a long period.

PREPARATION OF CEREAL PRODUCTS:—Cereals used in canned meat products should be clean, sound and dry. They should be of proper maturity, size, texture and free from insects, dust, grit and hulls. In most cases cereals require cooking before being mixed with other ingredients. None of the water used in these operations should be used in the preparation of the product. Some manufacturers feel it is necessary to flush the precooked cereals with cool, clean water in order to prevent lumping or matting and to avoid excessive starch flavor.

GRAVIES are usually made by adding flour, seasoning and some caramel or coloring to the stock left over from the parboiling or braising operation. A more nutritious and better flavored product will result if the stock from the parboiling operation is concentrated rather than using tap water. In nearly all instances gravy should be made by adding the flour slowly to the cold liquid with constant agitation. After the gravy and spices have been thoroughly mixed and the bulk gravy is free from lumps, it is brought to a boil and is allowed to simmer for 3 to 5 minutes. It is desirable to keep the gravy hot until it is used in the canned meat product. In some instances it may be possible to use an uncooked gravy. However, to obtain a smooth texture and better appearance in the finished product, it is desirable to cook it for a short period of time.

In addition to certain preparatory procedures which enter into nearly all canned meat products there are some principles of canning applicable to all.

HOT AND COLD FILLING METHODS:—Canned meats should be filled into the can either hot or cold. In between temperatures are highly undesirable because of growth of microorganisms that may be present. The hot pack is the more common method used. The precooked ingredients are placed, while still hot, into the can and immediately sealed. A steam exhaust, steam jet or mechanical vacuum should be used just prior to sealing to insure adequate vacuum in the product. Temperature of filling by this method should be at least 160° F.

Cold pack may be used when certain precautions are observed. By this method raw meat is packed into the cans and the cans scalded under mechanical vacuum. The meat is cooked in the sealed cans sufficiently to insure keeping without refrigeration. This method of packing decreases the cost by eliminating labor and the time for precooking. Since all the meat juices are retained in the sealed can the flavor of the food prepared in this manner is superior to that prepared from precooked meat. Losses of meat nutriments are also prevented. There are some precautions that must be observed. If raw meat in large pieces is placed in the cans, some material must be placed in the can to absorb the juices that cook out of raw meat. This will necessitate a thick gravy, dehydrated vegetables or some dry cereal product that will absorb the meat juices. If finely chopped raw meat is placed in the can, adequate vacuum mixing prior to filling, at

a temperature not to exceed 35° F. will prove adequate precaution to prevent an undesirable appearing canned meat product.

NET WEIGHT should be controlled closely as both under-filling and over-filling are undesirable. Underfill may result in a lower quality product due to discoloration during processing, or a collapsed can. Overfilling will result in a financial loss to the manufacturer, and may also be the cause of insufficient vacuum due to lack of headspace.

HEADSPACE:—This is determined by the difference between the volume of the contents and the possible cubic contents of the can. Net headspace is measured as the distance from the top of the can to the surface of the contents.

VACUUM in canned meat is obtained by

1. Thermal exhausting
2. Mechanical exhausting

Thermal exhausting is obtained by taking the product immediately from the cooking vessel, to the filling and sealing machines. In some cases it is necessary to add more heat to the filled cans before sealing them. This may be done by placing them in exhaust boxes that contain hot water, usually heated by the injection of steam, or boxes that are filled with perforated steam pipes which direct steam at the sides of the cans.

Mechanical vacuumizing is accomplished by specially designed machines. After the cans are filled, the covers are clinched on loosely and the cans fed into the vacuum chamber of the machine, which is pre-set to the degree of vacuum desired. The cans are then sealed while in the chamber. This method is suitable for both cold-packed or hot-packed products. It is the only satisfactory method for cold-

PROCESSING principles discussed under vegetables are also applicable to all canned meat products. The table on page 185 suggests processing schedules for the various types of canned meats. However, a processing schedule for any given product should be checked with the research laboratory of The National Canners Association, or the can manufacturer supplying the cans.

CANS:—Two types of cans are used for canned meats, sanitary cans and hole-and-cap cans. Most canned meats are now packed in sanitary cans with hole-and-cap limited to a few items.

Hole-and-cap cans have a soldered side seam. The meat is put through the hole in the top. This hole varies in diameter with the size and shape of the can, and the product that is being handled. The hole-and-cap can is closed with a cap which is soldered on. In the center of the cap is a vent, which is protected on the underside by a cleat and designed to prevent pieces of meat from closing the vent and thus preventing the extraction of air from the can. The cans are usually rectangular and frequently pyramidal in shape.

Sanitary cans are characterized by solder free, double seamed ends and soldered side seams.

TYPES OF TIN PLATE:—The cans used for canned meats are coated with tin, the weight of which is designated as 0.5-1.5% of the total weight. The most common type is hot-dipped tin plate, consisting of a cold-rolled steel base tin-plated by immersion in molten tin. Hot-dipped tin plate bears a greater percentage of tin than electrolytic tin plate.

The electrolytic process permits close control of the amount of tin to be applied. This is usually known as 0.5 tin plate and [illegible] number of non-acid foods. It is recommended that a [illegible]ally designed inside enamel be used when packing [illegible] the 0.5 tin plate can.

SEALING is one of the two basic operations of the canning [illegible]. Care should be taken that none of the product hangs [illegible] the edge of the can. An imperfect seal permits micro-

CLEANING (before retorting):—After the cans are filled and sealed, it is advisable to pass the can through a detergent spray washer to remove grease and bits of the product adhering to the can. The cleaning operation should consist of a hot water pre-rinse, then a suitable detergent spray wash followed by a warm, fresh water rinse.

SANITATION:—Good sanitary practices are absolutely necessary in every stage of canning. The production manager must set up a sound system of sanitation and see that it is strictly followed.

Molds, yeasts and bacteria are the chief causes of food spoilage. The principle underlying all methods of food preservation is the creation of unfavorable environmental conditions under which the organisms that cause spoilage can not grow.

The more common type of bacteria grow best at the temperatures ranging from 77-98° F., depending on the individual species. Temperatures below 41° F. retard their growth.

Some type of bacteria, called thermophiles, will grow best at high temperatures, often exceeding the thermal death point of the more common types. They are of particular concern to canners because they are apt to survive normal cooking processes and later cause the product to spoil.

Meats and gravies are excellent mediums for the growth of bacteria. It is important that these products be handled rapidly during the canning operation. Delays, particularly between the processing and closing operations are dangerous, since bacterial growth increases as the temperature drops.

EQUIPMENT required for the manufacture of canned meats is listed in the following table. Specific equipment used in the preparation of each product will be listed under the discussion of that product.

ESSENTIAL EQUIPMENT FOR MEAT CANNING PLANTS

PREPARATION EQUIPMENT

Refrigerators (temperature range 25-450° F.)
Meat rails and roller meat hooks
Boning tables with accessories such as hot water baths for knives, etc.
Boning knives, steels, meat hooks, finger guards, etc.
Meat grinders
Silent cutter
Roto cutter
Rotary meat cutter
Meat trucks
Mechanical mixers, 500 to 1000 lb. capacity
Liquid mixers for making gravies
Steam jacketed kettles
Par-boiling baskets

FILLERS

Hand fillers
Semi-automatic fillers
Mechanical fillers, including sausage stuffers
Juicers

NET WEIGHT SCALES

Small balance for spices

PLATFORM SCALE

CANNING EQUIPMENT

Car runways (for empty and filled cars)
Closing and sealing machines
Vacuumizing equipment
Retorts and accessories such as automatic control devices. retort crates, hoists, dollies etc.
Empty can washer
Filled can washer

WAREHOUSE EQUIPMENT

Labeling machine
Box construction bench and accessories
Boxing or crating tables
Fork lift or suitable manual trucks

Roller conveyors
Strapping machines
Stencil cutting machine
Stencil brush and ink

INSPECTION EQUIPMENT

Incubation room
Office for inspectors

MANUFACTURING of the most popular meat items is discussed on the following pages. There are variations in the methods of manufacture but the general principles pertinent to the production of a quality product are given here.

CANNED BACON

Canned bacon is a cured and smoked product that is prepared from a good grade of pork bellies. The important point to remember in the manufacture of canned sliced bacon is that there must be a moisture salt ratio of approximately 5 to 1. This means that if there is 2½-3% salt in the canned product the moisture content can not be over 12-15%. The regulations governing meat inspection state that canned products which are processed without steam pressure cooking must be labeled "perishable—keep under refrigeration". However, in the case of canned bacon, this requirement is not usually stated on the label. The ingredient statement on the label does not require the curing compounds used in making the cured bacon to be stated. It should be pointed out that the process given earlier in the chapter is not a commercial sterilization process. Its purpose is to kill trichina larvae that might be present. This larvae, if not killed, may result in the consumer becoming seriously ill if the bacon were eaten raw. Pasteurization is not the only method of killing trichina larvae. Freezing of the cured or green bellies is also a satisfactory method for killing this parasite.

RAW MATERIALS:—The best grade of bacon is produced from fresh standard square cut seedless bellies of uniform quality, good confirmation, boneless and trimmed square on all edges. The bellies should be of such proportions, proper thickness, width and length to avoid extremes not suitable for forming and slicing. They should weigh in the range of from 9 to 17 pounds green weight. If frozen bellies are used they should not have been in the freezer longer than 90 days, should be bright in appearance and show no discoloration or other evidence of deterioration. The bacon used for canned bacon is cured by the dry cure method. Several formulae are used by the various manufacturers. Using 5 to 6 pounds of the following formula to 100 pounds of bellies will give a satisfactory bacon for canning.

Ingredients	Nitrate cure	Mixed cure
Fine granulated salt	2½ to 3 lbs.	2½ to 3 lbs.
Cane or beet sugar	1½ to 2 lbs.	1½ to 2 lbs.
Sodium nitrite	½ oz.	¼ oz.
Sodium nitrate	none	2 oz.

SLICING:—After the rind is removed it is chilled for 12 to 18 hours at a temperature of 20-25° F. The bacon is then placed in a forming machine where it is squared up. The chilled bacon should be brought to the slicing room only as it is needed for slicing. If the slab of bacon is split for a short can, arrangements should be made so both halves of the bacon slab are sliced simultaneously so there will be an equal portion of the fat and lean in each can. The slices are usually 3/32 to 4/32 inch in thickness.

The sliced bacon is rolled in parchment, after weighing, in such a manner that the paper is coiled throughout the roll. For the large sized can the bacon is usually wrapped in the flat ½, 1 or 1½ lb. package or solid pack as desired. If a flat can is used the bacon may be wrapped in a spiral on itself. In this case the can is usually lined with parchment paper. Some difficulty may be encountered inserting the bacon into the can. This may be overcome by being careful that the paper does not bunch up in the can, that the bacon is uniform and square with no pieces hanging over the edges and the slices are not too cold or stiff to make a compact roll.

VACUUM in the can must be obtained by mechanical closure. Full machine vacuum is suggested for the smaller sized cans of sliced bacon. For the larger pullman shaped cans a mechanical vacuum of 17 to 20 inches is suggested.

PROCESSING:—A pasteurization process as outlined (see page 185) may be used. However pasteurization treatment is not necessary for the stability of the product if a moisture-salt ratio of 5 to 1 is used.

CANS:—Plain, hot dip 1.25 lb. tin plate cans are suggested for this product though not necessary, as an inside enamel may be used. If a plain can is used a good grade of parchment paper is recommended. The following is a list of general can sizes for canned sliced bacon:

Can Sizes	Net Weight
307 x 109	8 oz.
307 x509	24 oz.
310 x 402 x 1108	5 lbs.
410 x 414 x 804	6 lbs.
410 x 414 x 1008	7 lbs.

SPECIAL EQUIPMENT to make square cut, clear, grade bellies include:

Bacon formers
Bacon slicers
Open kettle pasteurizing equipment

CANNED CORNED BEEF

The term "corned" is applied in its proper meaning to all meats preserved with salt which have their color fixed by nitrite. Canned corned beef is a cured canned meat product having a reddish color. Federal regulations specify that the finished product shall contain no more than 200 parts per million nitrite. If a long cure method is used it further specifies that the maximum amount of sodium nitrate and/or potassium nitrite is 2 pounds per 100 gallons of pickle.

Corned beef is made from all parts of the carcass though flanks, plates, chucks and trimmings are the most commonly used. Canner and cutter grades of beef are almost exclusively used. The better grades of beef require considerable trimming of fat which is a loss to the canner. The beef is boned and cut into pieces that can be readily cured and all bruises, ligaments, cartilaginous material and excess fat are removed. Frozen beef may be used providing it shows no evidence of deterioration. Gassy meat should never be used.

CURING METHODS:—The beef used in this product may be cured by any of the following methods:

LONG CURES: The beef is placed in a sweet pickle solution made of salt, sugar, saltpeter and water. It is held at a curing temperature of 36°-38° F. for 18 to 25 days, being overhauled two or three times during the curing process. The meat should have a bright red color throughout and a decidedly brackish flavor.

Quick Cure: The beef is parboiled to the desired tenderness and then all the liquid is drained off and replaced with the curing liquid. The curing pickle is made of salt, sugar and sodium nitrite and/or sodium nitrate. After the pickle has been added it is held at 140° F. until the curing is completed.

Dry Cure: The beef is cooked to the desired shrink and then ground. It is then placed in a mechanical mixer, sodium nitrite added and thoroughly mixed. The nitrite reacts with the meat in the mixer during the filling operation and in the can until such time as the temperature in the retort reaches a point which will inactivate the reactions.

PREPARATION:—Regardless of the methods used to cure the beef it will be necessary to parboil the meat to at least

a 35% shrink from its raw weight. This will permit the finished product to form into a nice, fairly compact loaf and prevent an excess of free liquid in the can. If the long cure or short cure method is used the meat should be ground through a plate having holes 1½ inches in diameter. If the dry cure method is used the uncured meat should be ground through a plate with holes ¾ inch in diameter.

FILLING may be accomplished by hand filler or rotary can stuffer. A rotary can stuffer is used for filling the hole-and-cap cans. Sanitary type cans are filled by the hand pack machine or a complete hand operation may be used. If this is done it will require a mechanical packer of some sort to force the cooked meat down into the can. For either method of filling it is necessary to check the weight of each can. Care must be taken that the meat does not hang over the edge of the can causing a defective closure, and the meat must not interfere with the capping operation.

CLOSING:—It is preferable to obtain a vacuum in the can by employing a mechanical vacuum closure. A vacuum may also be obtained by thermal exhausting. When the latter is used, it is suggested that the contents be at least 160° F. average temperature at the time of closing. As much heat as possible should be retained by prompt handling of the meat after parboiling.

CANS:—Sanitary type, hole and cap or rectangular metal cans are used for this product. They should be made throughout of 1.25 lb. tin plate. If a lighter tin coating is used, a sanitary or meat type inside enamel is suggested. The following can sizes are used:

Can size	Net weight
314 x 208 x 308 or 304 x 204 x 308 (rectangular)	12 oz.
600 x 313 x 804 or 414 x 410 x 804 (rectangular)	6 lbs.
300 x 310	12 oz.
603 x 700	6 lbs. 10 oz.

SPECIFIC EQUIPMENT:—Rotary can stuffer for hole-and-cap cans.

CANNED BEEF

Canned beef generally consists of coarsely ground beef, salt and meat broth, or a prepared jelly is added to complete the fill.

RAW MATERIALS:—The beef meat used should be of good canner or cutter grade. Cuts of chuck, rib, loin and round are used in the proportions as they exist in the carcass. The meat should be well chilled, boned and properly trimmed; free from bruises, cartilage, tendons, blood clots, coarse connective tissue and excess fat. Frozen beef of good quality and showing no signs of deterioration may be used.

PREPARATION:—The beef should be cut into pieces of suitable size for filling and uniform precooking. The size of the pieces depend on the canner or the demands of the trade. They may vary from 1½ inch cubes to pieces the size of the can.

A rotary meat cutter may be used to prepare the boned, trimmed and inspected meat into cubes or strips. A refrigerated cutting room is advisable if the meat is to be cut by hand. Meat cutters of the Enterprise type, when equipped with a 1½ to 2 inch plate and a two blade knife may be used, but the finished product does not have the attractive appearance of that cut by hand or disc cutter.

After cutting the beef to the desired size, the pieces are parboiled, braised or roasted for the purpose of shrinking and [illegible]. The meat is parboiled in simmering water or broth. If the meat is braised, no water is added to the meat in the kettle. The general practice is to shrink the meat during

required to obtain a 35% shrink in weight is approximately 30-35 minutes for parboiling or braising, depending on the size of the pieces and the quality of the meat. It is suggested that weight checks be made before and during precooking, to maintain the desired shrink. A better quality product is obtained by roasting or braising. Parboiling permits a greater quantity of meat to be handled in a shorter period of time with a minimum of labor.

FILLING of the cans is a hand operation. Filling may be accomplished by hand pack filler, by supplying meat to each operator who weighs directly into each can, or it may be weighed into pans and conveyed to the filling operators who pack the cans. A rotary can stuffer is used for filling the 1⅝ or 2½ inch hole and cap cans.

The salt may be added separately to each can by means of a tablet dispenser or dissolved in the broth as desired. Salt and broth are added in the proportion of ¼ ounce salt to 1 ounce broth per pound of meat. A jelly may be prepared from the salt and broth mixture by adding 10% gelatine or ¾% agar by weight. The hot broth and salt or the prepared jelly is ladled into each can as it is conveyed to the closing machine.

Prior to closure, care must be taken that pieces of meat do not hang over the sides of the can and become entrapped in the seam during closure, as this will result in defective seams. Meat hanging over the flange of the cans should be moved toward the center of the can and a dependable employee should see that this is done before the cans pass into the closing machine. Presses are sometimes used for forcing the meat down into the cans.

CLOSING:—A vacuum may be obtained by mechanical vacuum closure or by thermal exhausting. When thermal exhausting is used the contents of the can should be at least 160° F. at the time of closure. If broth is used it should be added hot. A mechanical vacuum of 20 inches is recommended.

CANS:—Plain hot-dipped tin plate is suggested for canned beef. If light weight tin coating is used a suitable enamel is required.

The following can sizes are usually used:

Can Size	Net Weight
314 x 202 x 308 or 304 x 204 x 308 (rectangular)	12 oz.
600 x 313 x 802 or 414 x 410 x 804 (rectangular)	6 lbs.
300 x 310	12 oz.
603 x 700	6 lbs. 12 oz.

SPECIAL EQUIPMENT:—Rotary can stuffer for hole and cap can.

CANNED MEAT AND GRAVY PRODUCTS

Canned meat and gravy products may be made from either beef or pork. It may be braised and a hot pack canning method used, or it may be uncooked and a cold pack canning method used. The latter method is simpler for manufacturing these products.

RAW MATERIALS:—For beef products, the beef should be of utility grade. Although lower grades are frequently used, they do not produce as acceptable a product as the better grades do. Best results will be obtained if the wholesale cuts of chuck, rib, full loin and round are used in the proportion in which they exist in the carcass. Frozen beef may be used if it shows no evidence of deterioration.

For canned pork and gravy, lean picnics, butts, loins and hams, with not more than 10% trimmable fat, are used. Frozen pork may be used if it has not been in the freezer more than 180 days, is sound, of good color and shows no signs of deterioration.

The flour used is generally one of the processed wheat [illegible] low in thermophilic bacteria count. Red dog, dark or

low grade flour should not be used because of high bacteria content.

Natural spices, prepared spice mixtures or essential oil of spices may be used. Each supply of spices should be checked as they vary considerably between lots.

Onion powder may be substituted for mature fresh or storage onions. The usual ratio by weight of fresh onion to onion powder is 8 to 1.

PREPARATION:— The trimmed meat should be cut into pieces of suitable size for uniform cooking and filling. The size of the pieces depend on the packer and the demands of the trade. They may vary from 1-½ inches to 3 inches in size.

If the meat is ground, a plate with holes from ½ to 1¾ inches in diameter should be used, depending on the size of the can. If a No. 2½ size can is used the meat should be cut into 2 to 3 inch cubes or ground through a 1¾ inch plate. If a No. 1, or smaller can is used, most efficient results will be obtained by grinding the meat through one of the smaller size plates.

After cutting the meat to the desired size, the pieces are then ready for braising or mixing with the gravy paste. No water is added to the steam jacketed kettle during the braising operation. The general practice is to shrink the meat about 30%. The meat should be stirred during braising to secure uniform heating. It should not have a raw or pink appearance after braising.

Pork should be braised as described above for such time as is necessary to produce a 25% shrink from its raw weight.

The juices from braising the meat are retained and used in the preparation of the gravy.

Gravy Formula for Braised Meat

Meat broth	66 gallons
Ground raw onions	130 pounds
Tomato puree	56 pounds
Salt	55 pounds
Wheat flour	37 pounds
Sugar	3 pounds
Ground black pepper	3 ounces

In preparing the gravy, the wheat flour should be mixed with a portion of cold water to make a smooth paste. The paste is gradually diluted by adding the juices retained from the braising operation in the amount suggested in the formula. The onions, tomato puree, salt, sugar and ground black pepper are then added with constant stirring until thoroughly blended. The gravy should be brought to a boil and allowed to simmer approximately 30 minutes with ocassional stirring. The trimmed onions are ground or diced just prior to adding into the gravy mixture, thus minimizing discoloration by oxidation. Grinding through a plate having ¼ inch holes or dicing to ¼ inch cubes produces pieces of satisfactory size. The juices obtained from grinding should be retained and added to the gravy as part of the onion component.

Gravy Paste for Unbraised Meat

Water	18 pounds
Wheat flour	17 pounds
Tomato puree	11 pounds
Onion powder	10 pounds
Salt	8 pounds
Ground black pepper	4 ounces
Caramel coloring	4 ounces

Hydrolyzed plant proteins or monosodium glutamate, mushrooms, bay leaves or commercial spice mixtures may be added to the gravy to enrich the flavor.

Gravy paste is prepared in the same manner as described above for gravy except that it is not cooked.

After preparing the gravy paste, the raw pieces of meat are placed in a meat mixer and the gravy paste gradually added with constant stirring. Mixing should continue until all the paste adheres to the meat, but care should be exercised to prevent breaking the pieces.

Each manufacturer must decide the proportion of meat to gravy to be used. A suggested adjustment would be 85% unbraised meat to 15% gravy paste by weight; 80% braised meat to 20% gravy by weight.

The gravy for the braised product may be added mechanically or by hand. It should be at least 160° F., at which temperature a thermal vacuum is possible. For the unbraised, cold pack product, a mechanical vacuum must be used.

CANS:—Hermetically sealed open top style round, either commercial 1.25 lb. hot dip tin plate or commercial .5 lb. electrolytic tin plate may be used. Cans containing pork and gravy should be inside enameled regardless of the weight of the tin plate.

The can sizes usually used are:

300 x 409	1 lb.
307 x 409	1 lb. 4 oz.
404 x 404 or 401 x 411	1 lb. 14 oz.
404 x 414	2 lbs. 2 oz.

CHILI CON CARNE

Federal Regulations require that "products labeled Chili Con Carne shall contain not less than 40% of meat computed on weight of the fresh meat". Head meat, cheek meat and heart meat (exclusive of the heart cap) may be used to the extent of 25% of the meat ingredients under specific label declaration. The mixture may contain not more than 8% of cereal or soya flour.

Chili Con Carne with Beans shall contain not less than 25% of meat computed on the weight of fresh meat. Head meat, cheek meat and heart meat (exclusive of the heart cap) may be used up to 25% of the meat ingredients under specific label declaration.

The amount of seasoning used depends greatly on the section of the country the manufacturer serves.

RAW MATERIALS:—Beef of canner or cutter grade is usually used. The entire carcass should be used except that the tenderloins may be excluded. Shanks and plates should not be added from other trimmings. Frozen beef may be used

Chili con carne being filled into cans. Since this is a cold pack, the vacuum must be obtained by mechanical vacuum.

no signs of deterioration.

Suet or beef fat should be No. 1 cod or kidney fat. Fat obtained by trimming other meat may produce an undesirable product.

Beans should be clean, sound pinto or small red kidney.

Beet or cane sugar should be used. Do not use partially refined sugar.

Tomato product of good commercial grade that has a USDA grade (1.045 specific gravity) should be used.

Chili pepper should be made from the Mexican or California type chili peppers. Little or none of the stem should be added. The best peppers for this product are grown in the New Mexico and California regions.

Paprika of good commercial grade and color are used.

Onion and garlic, either fresh or powdered, may be used.

PREPARATION:—Part of the beef should be ground through a plate with holes 1 inch in diameter; the remainder (⅓ to ½) should be ground through a plate having ⅜ inch holes. Beef suet should be ground separately through a plate with ¼ inch holes.

The beans should be soaked in clean, pure water until they are nearly double their weight (about 8 hours) and blanched to remove any strong bean flavor. Sprouted, soured or mushy beans should be sorted out before they are mixed with the other ingredients.

Chili Con Carne Formula

Ingredients	pounds	ounces
Ground beef*	330	
Ground suet*	30	
Beans, dry*	115	
Tomato product	25	
Salt	10	
Chili pepper, ground	10	
Red pepper		4
Paprika	5	
Sugar	3	
Onion powder	2	8
Garlic		8
Comeno		8
Water	216	

*The beef and suet is figured on the raw weight basis; beans on the dry weight before soaking.

MIXING AND FILLING:—Place the ground beef, suet and spices in a mechanical mixer and start the mixing operation. The tomato product and water should then be added and finally the soaked beans. Mix until the beans are evenly distributed. Care should be taken so the product does not have an over-mixed appearance. Fill by hand or by a semi-automatic filler. Since this is a cold pack product the vacuum must be obtained by a mechanical vacuum.

Cans usually used—1.25 tin plate or 0.5 with inside enamel.

Can Size	Net Weight
404 x 404 or 401 x 411	1 lb. 14 oz.
404 x 414	2 lbs. 2 oz.
603 x 700	6 lbs. 12 oz.

CANNED HAMBURGERS

The Meat Inspection Division of The Department of Agriculture defines hamburger as follows: "Hamburger shall consist of fresh beef, with or without the addition of beef fat, with or without seasoning, and shall not contain more than 30% fat."

RAW MATERIALS:—The beef used should be of utility grade. Lower grades may result in an inferior flavor. The entire carcass should be used except that the tenderloins

Filling frying trays with mechanically formed hamburger patties. Pre-cooking is necessary to shrink patties about 30%.

sources should not be added.

Beef fat should be No. 1 cod or kidney fat. Fat obtained from trimmings other than beef should not be used.

Shortening, if used for frying, should be hydrogenated vegetable shortening with a high smoke point.

The flour should be a well milled wheat flour. Red-dog, shorts or middlings should not be used.

Tomato product should be a standard grade, 1.045 specific gravity.

Caramel coloring should be a good commercial grade.

Hamburger and Gravy Formula

The formula used will depend somewhat on the method of precooking. If the hamburgers are pan-fried or cooked in an oven, about 10% of the beef fat is incorporated with the beef. If deep fat frying is employed then beef alone will be used containing about 20-25% normally occuring fat. The following formula is suggested as a starting point and the spicing may be varied to secure a distinctive product.

Ingredients	Pounds	Ounces
Beef	90	
Beef fat	10	
Salt	1	8
Black pepper, ground		1¾

Onion is sometimes added at the rate of 5 to 10 pounds of ground onion per 100 pounds of meat or an equivalent amount of onion powder may be substituted for fresh onions (ratio of 1 to 8).

Frequently hamburgers are canned with a gravy with a basic gravy formula as follows:

Ingredients	Pounds	Ounces
Wheat flour	6	
Tomato product	11	
Caramel coloring		8
Water	80	

To this formula may be added such items as mushrooms, green peppers, pimento, onions or onion powder, and garlic or garlic powder.

PREPARATION:—The beef and fat if used, is prepared in a grinder of the Enterprise type using the 1½ inch plate, then mixed with the salt and seasonings. The mixture is then ground through the ¼ inch plate. The hamburgers are then formed into patties of the desired size by hand operated

Discharge end of a continuous deep-fat fryer. Worker is unloading trays of cooked hamburger patties onto a conveyor.

Packing deep fried hamburgers into field ration cans for the Armed Forces. If gravy is used, juicing machines deposit it.

automatic patty forming machines. It is necessary to allow for the shrink during precooking. For example, a patty about 4 inches in diameter will shrink to fit a 300 diameter can.

It is necessary to precook the hamburgers so that a shrink of 25-30% will be obtained. This may be done in an oven or by deep fat frying. Either method can be made continuous. Patties about ½ inch thick have been precooked sufficiently after 3 minutes in melted fat at 325° F.

In recent years there has been developed a method for frying hamburgers with infra-red rays. The hamburgers are conveyed through a tunnel equipped with infra-red bulbs, are automatically turned and continue through another tunnel, where they emerge uniformally cooked on both sides.

Another recent development has been the cooking of hamburgers in a ceramic oven. The absorption of heat by the ceramic material inside the oven, permits a uniform distribution of heat and a reduction of the amount of gas necessary to cook the hamburgers.

All of the above methods produce satisfactory results.

FILLING, VACUUMIZING AND SEALING:—The filling of hamburgers into a can is always a hand operation. However, when a hamburger and gravy product is manufactured, the gravy may be filled into the can with a juicing machine. This should be done before the hamburgers are placed in the can. Vacuum may be obtained by either thermal or mechanical method.

Cans commonly used—1.25 tin plate or 0.5 with inside enamel.

Can sizes	Net Weight
307 x 109	5½ ounces
300 x 200	6 ounces
300 x 409 (hamburger and gravy)	15¼ ounces

SPECIAL EQUIPMENT includes:
Hamburger forming equipment
Hamburger frying equipment
Deep fat fryer or oven fryer

CORNED BEEF HASH

This is a very popular ready-to-serve item. It is not only used in the home but manufactured in large containers for institutional use.

In addition to regulations promulgated by the Federal Food, Drug and Cosmetic Act and regulations of the Meat Inspection Division of the USDA, the product labeled hash "shall contain not less than 35% meat computed on the weight of the cooked and trimmed meat. The weight of the cooked meat used in this calculation shall not exceed 70% of the uncooked weight of the meat. Corned beef hash shall not be made with cereal, vegetable flour, dry skim milk or similar substances." The regulations concerning the limit of 200 parts per million of nitrite in the finished product of cured meats is also applicable to this product.

RAW MATERIALS:—The beef used for this product has the same requirements as found under Canned Corned Beef.

The potatoes may be any Irish variety if not of the mealy type. When storage potatoes are used they should be removed from storage and left at room temperature for several days before using.

Onions should be sound, mature and show no signs of rot or other pathological defects. If onion powder is used it should have the characteristic flavor of fresh onions.

PREPARATION:—The potatoes should be handled as previously outlined. When ready to use they may be ground through a plate having holes ⅜ inch in diameter, or diced into ¼ inch cubes. If dehydrated potatoes are used they should be ¼ inch cubes when reconstituted. They should be partially reconstituted before using.

The onions should be diced or cubed into ¼ inch pieces, or ground through a plate having holes ⅜ inch in diameter. All juices should be retained and added to the product.

The beef should be ground through a plate having holes ⅜ inch in diameter, placed in a kettle with pepper, salt, and nitrate and cooked until the meat has approximately a 30% shrink from its raw weight. After the proper amount of cooking, the other ingredients may be added and thoroughly mixed, or the beef may be removed from the kettle and combined with the other ingredients in a mechanical mixer.

Corned Beef Hash Formula

Ingredients	Pounds	Ounces
Beef	43	
Raw potatoes	49	
or		
Dehydrated potatoes	10	
Onions	2	8
or		
Onion powder		5
Sodium nitrate		.105 (3 grams)
Salt	2	
Pepper, ground black		6

FILLING:—The cans are usually filled on a semi-automatic filler. Vacuum may be obtained by a thermal or mechanical method.

Use sanitary cans 1.25 tin plate or 0.5 electrolytic with inside enamel.

Can Size	Net Weight
316 x 202 x 304 (rectangular)	12 oz.
312 x 105 x 310 (rectangular)	12 oz.
401 x 411	1 lb. 14 oz.
603 x 700	6 lbs. 12 oz.

MEAT AND VEGETABLE HASH

This product is known by several names: Meat and Vegetable Hash; Braised Beef Hash and Roast Beef Hash. The same Federal regulations apply as for Corned Beef Hash.

The raw materials and methods of preparation are the same as for Corned Beef Hash except that the nitrates are omitted in the formula and 3 pounds of celery salt are added.

MEAT STEWS

Meat Stews consist of a mixture of meat and vegetables in a gravy formulated from meat broth, flour and seasoning. There are numerous formulae which may be employed in preparing different types of meat stews such as Beef, Lamb, Irish, Brunswick or Boiled Dinner.

In addition to the regulations quoted for other products, the Meat Inspection Division requires that "products labeled as meat stews, for example beef stew, lamb stew and the like, shall contain not less than 25% meat computed on the weight of the fresh meat."

RAW MATERIALS:—The meat used in this product should be boned and trimmed as described for other products.

Beef should be of canner or cutter grades.

Pork—medium to good grades.

Mutton or Lamb—common to good grades.

Liver should be obtained from a US Department of Agriculture inspected plant.

Chicken meat—as prescribed for chicken products.

The potatoes should be prepared and handled as described for Corned Beef Hash.

Carrots should be firm, of moderate size, free from disease or rot, and rich in color. The red-cored Chantenay is a favorite variety of carrots grown for canning.

The celery should be firm and free of disease or rot.

Peas and Corn should be of a good commercial grade and purchased by sample.

PREPARATION:—The meat components should be ground through a plate having holes 1-½ inches in diameter and parboiled to obtain a 30% shrink of the raw weight.

The peeled potatoes are trimmed, inspected and washed in cold water. The washed potatoes are then cut into ½ inch cubes for which purpose mechanical dicers may be used. After dicing, the potatoes are blanched in water at 200° F. for two to four minutes. The purpose of the blanch is to stop enzymatic action which might cause surface discoloration during mixing and filling, and to partially precook the potatoes. The potatoes should be handled without delay, particularly between peeling and blanching, but if they must be held for short periods, they should be immersed in a 2% salt brine to prevent darkening.

Carrots should be thoroughly washed to remove soil and [illegible], and sorted to remove any that are diseased or damaged. They should be peeled by one of the methods described for potatoes, and trimmed, including clipping of both ends and removing discolored portions. They are then sliced or diced into [illegible] cubes. They should be kept under

The onions should be prepared as described for corned beef hash.

GRAVY:—The gravy should be prepared by using the broth from parboiling or braising. The wheat flour is mixed with a portion of cold water to make a smooth paste. The paste is gradually diluted by adding the broth in the amount suggested in the formula. The chopped onions, salt, and ground black pepper are then added with constant stirring until thoroughly blended.

FILLING:—This may be accomplished either by means of a plunger type filler or semi-automatic filler, depending upon the size of the can being used. The gravy may be filled separately with a juicer. If this is done the cans should be inverted after cleaning and processing. Proper vacuum may be obtained by filling the product at a temperature of 160° F. or higher, or by mechanical means.

FORMULAE:—The following formulae are suggested as basic and can be modified to meet the requirements of the manufacturer's customers.

Beef Stew

Ingredients	pounds
Parboiled beef	93
Diced potatoes	90
Diced carrots	42
Chopped onions	15
Gravy	61

Lamb Stew

Ingredients	pounds
Parboiled lamb (30% shrink)	93
Diced potatoes	90
Gravy	60
Diced carrots	18
Chopped onions	18
Soaked, dried peas	12
Diced turnips	6
Chopped celery	3

Irish Stew

Parboiled mutton (30% shrink)	90
Diced potatoes	70
Gravy	61
Diced carrots	39
Soaked, dried peas	24
Chopped onions	15

The gravy used in the Beef, Irish, or Lamb stew is prepared from the following ingredients:

Ingredients	pounds
Broth	93.5
Processed flour	6.5
Salt	3.5
Ground black pepper	1.5

Brunswick Stew

Ingredients	pounds	ounces
Parboiled beef	12	
Parboiled pork	10	
Parboiled liver (20% shrink)	2	
Parboiled chicken meat	4	
Tomatoes	22	
Broth	20	
Corn	12	
Diced potatoes	7	
Chopped onions	7	
Tomato puree	6	
Salt	1	8
Red pepper		0.25
Black pepper		0.25

A delux stew can be prepared as follows:

Parboiled beef	50
Diced potatoes	32
Diced carrots	18
Gravy	50

Gravy

Wheat flour	3	
Salt	1	12
Ground black pepper		½
Onion powder (optional)	1	
Water	6	

Beef broth sufficient to make 50 pounds of gravy.

Potatoes and carrots may be cut into 1 inch cubes. The gravy is placed in the can first and then the beef, potatoes and carrots are added.

CANS:—Sanitary cans of 1.25 tin plate or 0.5 electrolytic. The following can sizes are most commonly used:

Can Size	Net weight
300 x 308	12 oz.
401 x 411	
or	
404 x 404	1 lb. 14 oz.
603 x 700	6 lbs. 12 oz.

BEANS WITH FRANKFURTERS IN TOMATO SAUCE

This is a relatively new product, being a result of war time development.

In addition to the Federal Food, Drug and Cosmetic Act, and regulations of the Meat Inspection Division, the latter requires that "products labeled beans with frankfurters and sauce, sauer kraut with weiners and juice, and the like, shall contain not less than 20% frankfurters or weiners computed on the weight of cooked and smoked sausage prior to its inclusion with beans or sauer kraut".

RAW MATERIALS:—Frankfurter sausage or weiners should be of good commercial grade with a mild spicing formula.

Beans may be pea beans, small white beans, medium white beans or large white beans. They should be equivalent to US grade No. 1 as established by US Standards for beans.

PREPARATION:—The frankfurters should be cut into ½-¾ inch pieces.

The beans should be soaked in clean, cool, pure water for approximately eight hours. They should then be blanched for sufficient time to slightly soften the cotyledons and to remove any strong flavor. Remove all undesirable beans and split skins by mechancial means or hand picking.

The onions are prepared the same as for beef hash.

Formula

Frankfurter pieces	29 pounds
Beans, dry	19 pounds
Tomato sauce	34 pounds

Sauce Formula

Tomato product	25	gallons
Sugar	52	pounds
Salt	15	pounds
Raw ground onion	2 pounds 8	oz.
Ground allspice	2	oz.
Ground cinnamon	2½	oz.
Ground cloves	2	oz.
Ground mace	1	oz.

Water—sufficient to make 100 gallons of sauce.

Place the tomato product with water in a mechanical mixer and blend thoroughly. Add the remaining sauce ingredients, stirring constantly until well mixed. To prevent souring, or other spoilage, the sauce should be held at 50° F. or lower, until ready to use.

FILLING:—The frankfurter pieces and the soaked beans are mixed together and filled into cans. An automatic or semi-automatic filler is usually used for the sausage pieces and beans. A juicer is used for the tomato sauce, which is placed into the cans first. A mechanical method should be used to obtain the proper vacuum.

CANS:—Use sanitary cans of 1.25 tin plate or 0.5 electrolytic with inside enamel.

The can size usually used:

211 x 400 .....15 oz. net weight

LUNCHEON MEAT

This product is not usually placed on the market under the name of Luncheon Meat. More familiar trade names are Spam, Mor, Prem and Treat. A product that is almost identical in nature but is made exclusively from heavy hams, and is somewhat more heavily spiced, is known as spiced ham, or chopped ham. Some luncheon meats, especially those placed in large cans, are not given sufficient sterilization to permit them to be handled without refrigeration. Therefore, under Federal regulations they must be marked "perishable—keep under refrigeration". In addition, the Meat Inspection Division regulations state that "this product being a cured meat product, shall contain not more than 200 parts per million of nitrite in the finished product".

RAW MATERIAL:—The cuts of meat used in this product are picnics, butts, loins and hams, with not more than 10% trimmable fat. Frozen pork may be used if it has not been in the freezer more than 180 days, is sound and shows no signs of deterioration.

Beef should be of canner and cutter grades. Best results will be obtained if wholesale cuts of chucks, rib, full loin and round are used. Frozen beef may be used if it has not been in the freezer over one year and shows no evidence of deterioration.

PREPARATION:—The meat should be placed in layers not more than eight to ten inches thick in a cooler, not over 28° F. for 14-18 hours. The meat should then be removed and the pork trimmings ground through a plate having ⅜ inch holes. The beef trimmings should be ground through a plate having ⅛ inch holes. The ground meat is then placed in a roto-cutter or silent cutter and chopped to a fine consistency. During the chopping operation the salt, sugar, nitrite and other spices may be added. After thorough chopping and mixing, the chopped meat should be placed in a vacuum mixer and mixed under 26-28 inches of vacuum for 5-8 minutes. In lieu of adding spices and curing material in the

Cans of meat on left are being tamped and check-weighed. Cans on right are traveling through crimper to vacuum closer.

chopper, it may be dissolved in a small quantity of water and added during the mixing operation.

If a vacuum mixer is not available, the chopped meat may be placed in meat trucks and put in a vacuum chamber where it should be held under 26-28 inches vacuum for not less than 10 minutes. The meat trucks with finely chopped meat are then placed in a 35°-38° F. cooler for 12-24 hours. This is known as the curing period. After the curing period the meat is again mixed in a vacuum mixer or chamber as before. The product is then placed in a sausage stuffer filler. The temperature of the product at the time of filling should be between 36°-38° F.

FILLING of the cans may be accomplished by means of a sausage stuffer equipped with a special attachment to deliver a definite volume of product, or a stuffing horn attachment where the operator adjusts the fill-in, or for the smaller size cans an automatic filler is available. The dimensions of the stuffing horn should be approximately ¼ inch less than that of the can. The parchment liner is wrapped around the horn and folded over the opening thus covering the bottom of the can. Care must be taken to press the can firmly on the filling attachment to avoid air pockets during filling. It is good practice to have one or more stuffers than operating crews to prevent loss of time in filling and tamping the stuffers. Tamping is necessary to avoid air pockets. A satisfactory arrangement is to have two stuffers connected to each filling attachment. The filled cans must be check-weighed and adjusted if necessary.

Vacuum in the cans is obtained by mechanical vacuum closure. A vacuum of 26 to 28 inches is suggested. High mechanical vacuum closure depends on proper vacuum mixing and filling to prevent the product from being drawn out of the can. It is suggested that the filled cans be tamped by hand prior to closure to obtain sufficient headspace and satisfactory can vacuum. The two wide sides of the closed rectangular can should show distinct concavity. Those cans not showing this condition should be opened and the product repacked.

The following formulae are basic and may be varied according to supply, cost of the meat and demands of the trade:

Pork Luncheon Meat

Picnics	700	pounds
Butts	150	pounds
Shanks	150	pounds
Salt	35	pounds
Sugar	20	pounds
Sodium nitrite*	2.5	ounces

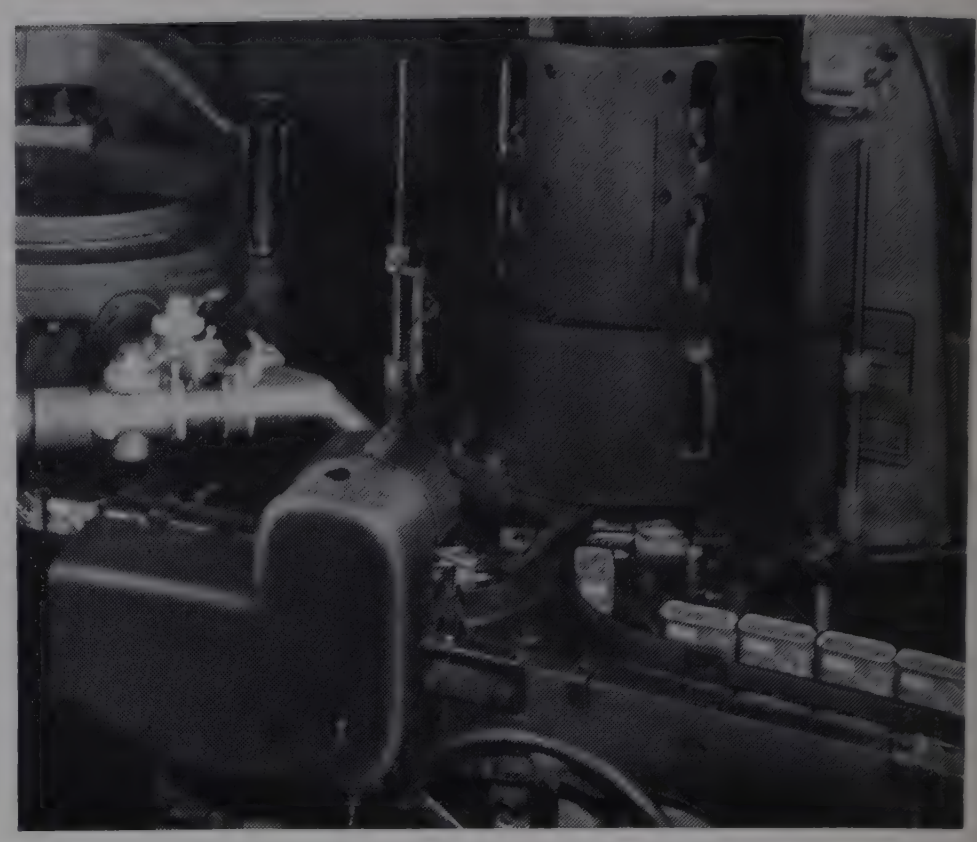
Spiced Ham

Boned heavy hams	1000	pounds
Salt	35	pounds
Sugar	20	pounds
Sodium nitrite*	2.5	ounces
White pepper	7.5	ounces
Coriander	2.5	ounces

* It is advisable to add 2 ounces of sodium nitrite per 100 pounds of meat if the meat is to be held in cure for a period longer than 24 hours.

Beef and pork luncheon meat can be made by substituting beef for one half of the pork. If veal or lamb luncheon meat is made, either of these can be substituted for pork in sufficient quantities to modify the flavor of the finished product.

The 401 x 411 rectangular cans are processed under water with additional air pressure to prevent straining of the ends. The cans should be separated ¼ to ½ inch by metal dividers to avoid reduction in sterilization value. If dividers are not used the process should be increased to compensate for the



Luncheon meat is forced into cans under 95 pounds per square inch pressure by this machine, at rate of 120 cans a minute.

CANS:—Use sanitary cans of 1.25 tin plate or 0.5 electrolytic with inside enamel.

Size of can	pounds	ounces
314 x 202 x 304 or 312 x 115 x 310 (rectangular)		12
300 x 308		12
401 x 411 or 404 x 404	1	14
404 x 414	2	2
402 x 310 x 1204 or 402 x 314 x 1200 (rectangular Pullman type)	6	

SPECIAL EQUIPMENT needed is as follows:
28° F. coolers.
Mechanical vacuum mixer or vacuum chambers.
Attachment or horns for sausage stuffer.
Special closing equipment for sealing rectangular or square cans.
Dividers for retort baskets.

LIMA BEANS WITH HAM

This is a relatively new product, a result of wartime development.

In addition to the regulations promulgated under the Federal Food, Drug and Cosmetic Act, the regulations prescribed by the Meat Inspection Division of the USDA require that "products labeled Lima Beans with Ham and Sauce, Beans with Bacon and Sauce and the like, shall contain not less than 12% ham or bacon computed on the weight of the smoked ham or bacon prior to its inclusion with the beans and sauce".

RAW MATERIALS:—Ham used should be a good commercial product, mild in flavor and in a relatively light weight range.

Beans should be mature, large lima beans. Baby limas may be used if they do not contain immature large lima beans, which gives the product an undesirable mushy appearance.

PREPARATION:—The ham should be skinned, boned and the outside covering of fat trimmed to ¼ to ½ inch thickness.

be cut into 1-½ inch pieces. An economical product can be made by grinding the ham through a plate having holes 1 to 1-½ inches in diameter.

The lima beans should be hand picked or sorted by mechanical means to remove discolored beans, skins and foreign material. After cleaning they should be soaked in water at 90° F. for one hour. After soaking, the beans should be blanched in water at 190° F. for sufficient time to slightly soften the cotyledons and remove any strong bean flavor to the product.

Formula

Ingredients	pounds
Lima beans, dry	40
Ham, cured	20

FILLING:—The product can be filled by hand or by machine in approximately the same ratio as in the formula. Frequently plain tap water is used to top off the cans. A sauce of flour and gravy may be used. Thermal exhaust may be obtained by the use of a hot flour gravy although a mechanical vacuum method would be preferable for this product.

CANS:—Sanitary cans of 1.25 tin plate are recommended.

Can Sizes	Net Weight
(No. 1) 211 x 400	10½ ounces
(No. 2) 307 x 409	20 ounces
(No. 2½) 401 x 411	30 ounces

MEAT AND NOODLE PRODUCTS

Meat and noodle products consist of beef and noodles, beef, pork and noodles, chicken and noodles.

RAW MATERIALS:—Egg noodles specially produced for canning are required to withstand the high processing temperatures and to add a good appearance to the finished product. The noodles should be made from 100% durum semolina with an ash content of not more than 0.78% and a protein content of not less than 12.2%, calculated on a moisture free basis. The finished noodles shall have an egg solids content of not less than 9.0% and a moisture content of not more than 13.0%. The noodles should be 0.055 to 0.065 inches thick, approximately ⅛ to ¼ inches wide and not less than 2 or more than 2-½ inches long.

Beef (See beef and gravy).

Pork (See pork and gravy).

PREPARATION:—The noodles should be cooked in a 1% brine solution (salometer reading of 4°) for such time as is necessary to obtain a yield of approximately 260% based on dry weight. After cooking, flush with cold water to prevent them from lumping and imparting a starchy flavor to the finished product.

Beef and pork when used, should be properly boned and trimmed. It is then ground through a plate with ¾ inch holes. Plates with holes up to 1-½ inches may be used, depending on the appearance desired in the finished product. The meat should be braised to a 30% shrink from its raw weight. All juices from the braising operation should be included in the finished product. It may be necessary to add a little water to get the desired consistency of the finished product.

Ingredients	pounds	ounces
Cooked noodles	50	
Raw beef	40	
Raw pork trimmings	6	
Onions		4½
Salt	1	6
Black pepper, ground		⅛

FILLING:—When the noodles are cooked and have been flushed with cold water, they are placed in a mechanical mixer and thoroughly mixed with the meat and other ingredients. Care should be taken so as not to over-mix the product. It should then be filled into the cans with semi or automatic equipment. A thermal or mechanical exhaust may be used on this product.

CANS:—Use sanitary cans of 1.25 tin plate or 0.5 electrolytic plate with inside enamel.

Can sizes	Net weight pound	Net weight ounces
211 x 304		8
211 x 400		10½
300 x 401	1	
307 x 409	1	4

BEEF OR PORK SAUSAGE IN WATER OR BRINE

This will cover the manufacturing of Frankfurters, Vienna Sausage, Weiners and Sausage in oil. The same basic principles are applicable in the manufacture of these products. In the product called "Weiners with Barbecue Sauce", the sauce is packaged in a flexible container and placed in the can with the weiners.

The regulations promulgated under The Federal Food, Drug and Cosmetic Act and regulations under the meat inspection division govern the manufacturing of these products.

RAW MATERIALS:—The meat used in this product is usually a mixture of beef and pork trimmings. Meat by-products such as lungs, lips and tripe may also be used. These products, however, have a poor binding quality and do not retain moisture, giving a low drained weight after processing. Bull meat has excellent binding qualities. The fat content of the meat should not be excessive to prevent undue rendering in the can. Frozen trimmings may be used in a moderate amount.

The beef is usually of canner or cutter grade. Steers, heifers, stags and bulls may be used. The pork trimmings should not contain more than 50% trimmable fat. Trimmings from the head and seedy parts of the belly should not be used. Frozen pork up to 50% may be used. The meat should be boned and properly trimmed as for other canned meat products.

If cereal or milk powder is used it is limited to 3½% in federally inspected plants and the label must read "cereal added".

The casing should be commercial grade—16 to 24 millimeters, sheep or artificial.

PREPARATION:—The trimmings are ground through a ⅜ inch plate and chopped in the silent cutter or roto-cutter in the following order: the beef is placed in the cutter first, followed by the salt, spices, cure and ice or cold water. The pork is added last to lessen the amount of breakdown of the fatty tissue. Chopping is continued until a finely cut product is obtained.

The finely chopped product is placed in a sausage stuffer, care being taken that the product is packed tight to expell all entrapped air to avoid trouble during the stuffing operation. Linking may be done by hand or by a linking machine. Weiners and frankfurters are linked ¼ inch less than the height of the can to be used in the packing of the product.

For vienna sausage, the product is stuffed into four foot links and hung over a smoke stick forming two 24 inch lengths and immediately taken to the smoke.

During the smoking and cooking operation it is desirable to shrink the sausage well and anticipate reabsorption of some of the moisture by the sausage while it is being processed in the can. This is advantageous for two reasons:

(1) It is easier to pack the sausage into the cans.

(2) There is less danger of casings being split.

The exact time and temperature to be followed in smoking

depends on several factors. The type of smokehouse and the relative humidity and velocity of air circulation in the smokehouse play an important part. In order to establish the desired schedule it is suggested that the smokehouse temperature be held at 110-130° F. for two hours and at least 160-170° F. for 1 and ½ hours. A moderately heavy smoke is maintained. The sausage is then transferred to a vapor cooker and held 8 to 12 minutes at 160° F. After a cold water spray, the sausage is allowed to dry and held in a cooler until canned. If artificial casings are used, they are removed after cooling.

A 12-15% shrink may be expected during the smoking and cooking operations.

The sausage is taken to the canning floor and in the weiner and frankfurter products, the links are separated. The Vienna sausage links are cut ¼ inch less than the height of the can. This may be done by hand, using a miter box, or mechanically by a slotted conveyor with rotary knives properly spaced.

FILLING the cans is a hand operation. An assembly line system may be used in which case the sausage is weighed into cans and conveyed to fillers who place the weighed sausage into each can. Another method often used is to place the approximate weight of sausage in each can and conveying them to the check weighers who adjust the weight in each can. Care must be taken in placing the proper weight in each can to obtain the labeled drained weight after processing. The fill is then completed with water, or a 2% brine solution. If a thermal exhaust is used the liquid should be added at not less than 160° F. Care must also be taken to see that the ends of the sausage are covered with liquid to prevent discoloration. If a mechanical vacuum is used, the topping liquid may be 50-70° F. A mechanical vacuum is preferred for this product. A 14 inch vacuum is suggested as a higher vacuum may draw some of the water from the can before it is sealed.

FORMULAE:—The type of meat ingredient used will vary with the customer's demand, competitive prices and availability of raw material.

Formula No. 1

Beef	40-70%
Pork trimmings	30-60%

At least 50% of the beef used should be bull meat.

Formula No. 2

Bull meat	50%
Beef trimmings	20%
Regular pork trimmings	20%
Beef hearts or tripe	10%

The following spice formulae are suggested for each 100 pounds of meat:

Seasonings for Vienna Sausage

Salt	3	pounds
Corn sugar	8	ounces
Pepper, ground	6	ounces
Mustard, ground	4	ounces
Sodium nitrate	½	ounce

Seasonings for Frankfurters and Weiners

Salt	3	pounds
Corn sugar	8	ounces
Pepper, white, ground	6	ounces
Coriander, ground	2	ounces
Mace, ground	1	ounce
Sodium nitrite	¼	ounce

CANNED SAUSAGE IN OIL is manufactured for a special trade and is a favorite among the lower income [illegible]

large pieces of smoked, cut links packed in vegetable oil.

PREPARATION for this product is the same as outlined for the sausage products above except for the following points:

Meat: More by-products, such as cheap head meat, lips, tripe, lungs, snouts and trimmings from veal and mutton are used.

It usually contains more fat and is heavily spiced. It is stuffed into beef middles or artificial casings of the same size.

Refined cotton seed, soya bean or other suitable vegetable oils are used.

After smoking, the product is not usually cooked, but given a cold water spray and allowed to dry. It is then transferred to a 40° cooler until canned. The sausage links are cut into 1½ to 2 inch lengths either by hand or automatic slicer. About 80-85% of the can's contents consists of sausage and the remainder is oil.

A mechanical vacuum of 15 to 18 inches is recommended for this product.

Suggested Formula

Ingredients	Pounds	Ounces
Beef trimmings	200	
Beef tripe	70	
Beef hearts	80	
Ice or cold water	10	
Salt	10	
Sugar	1	12
Pepper, ground, black	1	8
Allspice, ground		8
Mace, ground		6
Red pepper, ground		1
Sodium nitrite		⅞

CANS:—Use sanitary cans with 1.25 tin plate or 0.5 electrolytic with inside enamel. Can sizes usually used for these products are:

Can size	Net Weight
208 x 208	4 ounces
211 x 400	9 ounces
401 x 411 or 404 x 404	1 pound 6 ounces
603 x 700	5 pounds
For Sausage in Oil:	
404 x 211	12 ounces
502 x 500	3 pounds
603 x 700	6 pounds

SPECIAL PRECAUTIONS:—In the canning of sausage products certain precautions should be taken to avoid difficulties.

(1) Products may contain not more than 3½%, individually or collectively of cereal, vegetable starch, flour, soya flour or dry milk. When any of these ingredients are used, it must be declared on the label.

(2) The product may contain not more than 10% of added water. Ice or cold water should only be added when it is necessary to keep down the temperature during the chopping operation.

(3) Split casings may be caused by the following:

(a) Poorly selected or handled casings. Storage at temperatures above 40° F. may produce a loss in strength of the casings.

(b) Coarse chopping of the meat will entrap more air in the casing which, upon retorting, expands the product rupturing the casing.

(c) Under-packing of the cans. When the sausages are loosely packed, too rapid expansion of the casing is

permitted.

(d) The relation of the retort temperature to the retort pressure during the blowdown of the retort. Pressure cooling should be employed for the larger sized cans.

(e) The percentage of moisture added to the meat during preparation. Too high a moisture will rupture the casing during retorting.

(f) Retorting the canned product at too high a temperature.

SPECIFIC EQUIPMENT includes the following:
Stuffing horn for sausage stuffer.
Smoke house
Linking machine
Stripping tables (for removing artificial casings.)
Miter box or automatic slicing machine.

CANNED PORK SAUSAGE PRODUCTS

Canned Pork Sausage products include such items as bulk pork sausage, pork sausage links and pork sausage patties.

The Meat Inspection Division states that "Pork sausage and Breakfast sausage, whether fresh, smoked or canned, shall not contain more than 50% trimmable fat; that is, fat that can be removed by thorough, practical trimming and sorting."

RAW MATERIALS:—Fresh, lean shoulder pork, picnic ham or trimmings may be used. Bruised or oily pork, dark flesh, coarse muscle fibers and frozen pork should not be used. The meat should be in prime condition. For pork sausage meat, or links, the pork may contain 20% trimmable fat. Pork sausage patties should contain not more than 10% trimmable fat.

Salt, sugar and spices—See general.

PREPARATION:—Same as for luncheon meat.

Formula No. 1

Ingredients	Pounds	Ounces
Pork	100	
Salt	2	8
Sage		2
Sugar		8
Pepper, ground, black		4

Formula No. 2

Ingredients	Pounds	Ounces
Pork	100	
Salt	2	8
Sage		1
Pepper, ground, black		7
Savory		⅝

Formula (Pork sausage patties)

Ingredients	Pounds	Ounces
Pork	100	
Salt	2	
Sugar		8
Pepper, ground, black		2
Sage		2

Formula for gravy

Wheat flour	4	
Caramel coloring		8
Water	95	

FILLING:—Bulk sausage as outlined for luncheon meat. For pork sausage links, the meat is placed into a stuffer to be filled into 18-26mm sheep casings. The links should be about ¼ inch shorter than the height of the can to be filled. The filling operation is the same as for frankfurters, except that the links are wrapped in a parchment paper. After the can is packed with pork sausage links it is topped with a 2½% brine solution.

Pork sausage patties are prepared in the same manner as hamburgers.

CANS:—Sanitary cans with a 1.25 tin plate should be used. Can sizes usually desired are:

Bulk Sausage

Size	Net Weight
401 x 411	1 pound 14 ounces
404 x 414	2 pounds 2 ounces
314 x 202 x 304 or 312 x 115 x 310 (rectangular)	12 ounces

Pork Sausage Links

208 x 208	4 ounces
211 x 400	9 ounces
401 x 411 or 404 x 404	24 ounces
404 x 414	32 ounces

Pork Sausage Patties (without gravy)

300 x 200	5 ounces
300 x 308	9 ounces

Pork Sausage Patties (with gravy)

300 x 308	11½ ounces
300 x 409	15¼ ounces

MEAT BALLS AND SPAGHETTI—WITH TOMATO SAUCE

The Meat Inspection Division requires that "Spaghetti with meat balls and tomato sauce, spaghetti with meat and sauce and similar products, shall contain not less than 12% meat computed on the weight of the fresh meat. The presence of the sauce or gravy constituents shall be declared prominently on the label as part of the name of the product. Meat balls may be prepared with not more than 12%, singly or collectively, of farinacious materials such as soya flour, dried skim milk, and the like."

RAW MATERIALS:—Use beef, spices and shortening the same as for hamburgers.

Spaghetti of good commercial grade should be used. A canning spaghetti, containing 2 pounds of egg albumen solids to 100 pounds of durham semolina, is recommended. This will eliminate mushy spaghetti in the finished product.

Formula

Ingredients	Pounds	Ounces
Beef, raw	24	
Salt		6
Pepper, ground, black		½
Spaghetti	13	
Sauce	52	

Formula for Sauce

Tomato puree	58	12
Water	29	8
Salt	3	
Sugar	3	8
Flour	3	12
Onion powder	1	8
Pepper, ground, black		1

PREPARATION:—The spaghetti should be cut into approximately 4 inch lengths and cooked in boiling water for sufficient time to increase it's weight 150%. After cooking, it should be flushed with cold water to prevent matting or imparting a starchy flavor to the finished product.

The meat balls may be prepared by the method outlined for hamburgers, each meat ball weighing about ½ ounce. They may be cooked in water or placed in the can raw. The latter procedure is preferred.

The sauce is made by placing the tomato product in a mechanical mixer with water and mixing until thoroughly blended. The salt, flour, sugar, onion powder and pepper should be added slowly, with constant stirring, until a smooth paste is obtained. The sauce may be made without cooking and filled into the cans at a temperature between 40°-70° F. If cooking the sauce is desired, it should be brought to a boil and allowed to simmer from 3-5 minutes, and filled into cans at a temperature between 160°-180° F.

FILLING:—This product is usually filled by hand. A semi-automatic hand filler or a conveyor type filling table, may be used. It is suggested that part of the sauce be juiced into the can first, then a layer of cooked spaghetti, then the meat balls, and again a layer of cooked spaghetti and the can topped off with the sauce.

Thermal exhaust may be obtained if the sauce is added hot. If cold sauce is used, a mechanical vacuum must be used.

CANS:—Since the methods of manufacture vary greatly among can makers, it is impossible to give net weights for different size cans. The following can sizes are used: No. 1, No. 1 tall, No. 2, No. 2½ and No. 3.

MEAT BALLS WITH GRAVY

This product is manufactured as outlined for hamburgers, except that the meat is formed into ½ ounce balls and cooked in water, or placed in the can raw. If a flour gravy is used, it should be prepared as outlined for hamburgers. If a tomato sauce is used, it should be prepared as outlined for meat balls and spaghetti.

FILLING:—The procedure is the same as for meat balls and spaghetti. The weight of the meat balls in each can should be at least 40% of it's net weight.

CAN SIZES usually used are the same as for meat balls and spaghetti.

BEEF AND PORK TONGUE PRODUCTS

Canned beef tongue consists of cured and cooked tongues packed in gelatine or agar. It may be served hot or cold as slices, or minced. The regulations promulgated under the Federal Food, Drug and Cosmetic act and regulations of the Meat Inspection Division of the USDA are applicable.

RAW MATERIALS:—The tongue should be free from teeth marks, bruises, foreign material and evidence of scars. Tongues with slight cuts or those from which the tips have been removed are satisfactory. Frozen tongues of good quality may be used.

The agar should be of good edible commercial grade purchased on sample.

The gelatin should be of a good edible commercial grade with a 300 bloom.

PREPARATION:—If the chilled, trimmed tongues vary considerably in size, they should be separated into small, medium and large in order to secure a more uniform cooking and precooking operation. The small tongues are used for the smaller sized cans and for adjusting exact weights for the larger cans. After segregating and thoroughly washing with cold water, the tongues should be soaked in a strong pickle solution (80° plain pickle) overnight. This treatment loosens all muscular tissues of the tongue and saliva and any coating that forms on the surface may be easily removed.

CURING:—The soaked tongue should be thoroughly washed with cold water. They are then artery pumped and placed in [illegible] of sweet pickle cure. The following is a sug-[illegible] curing pickle.

[illegible] water)	100 gallons
[illegible]	8 pounds
[illegible]	12 ounces

38° F. Each lot of tongues should be examined prior to precooking to determine if they are thoroughly cured. This may be accomplished by cutting several tongues lengthwise to observe the color of the interior of the tongue. A light red, uncured area is observed when tongues are not sufficiently cured.

PRECOOKING:—The cured tongues should be flushed with cold water prior to precooking. They are precooked in boiling water for approximately 75 minutes to obtain a shrinkage of about 25%. The time required depends upon the size, the quality of the tongues, and the desired shrink. They should be stirred while parboiling to obtain uniform heating. It is desirable to employ wire baskets for suspending the tongues in the parboiling liquid. The precooking operation shrinks the tongues, minimizes excessive liquid in the canned product, tenderizes them, facilitates removal of bone and improves packing into containers. After precooking the tongues should be flushed by overflowing the precooking kettle with cold water so as to remove the excess fat. The chilled tongues are then skinned, trimmed free from bones, connective tissues, and excessive fat.

Beef tongues are always skinned, and this procedure is usually preformed after curing and precooking. It is believed that a better colored tongue is obtained when they are skinned prior to curing. If this procedure is followed, it is important to avoid over-scalding since this may have an adverse effect on the color. Also, scalding prior to curing tends to make it difficult to artery pump the tongues.

JELLY:—An agar solution may be prepared by soaking 4-½ pounds of edible agar in a small amount of cold water for an hour and adding the soaked agar to 100 gallons of boiling water. This mixture is then heated until the agar is thoroughly dissolved.

A gelatin solution may be prepared by mixing 2 pounds of gelatin (300 bloom) with 10 pounds of cold water, permitting the mixture to stand for approximately one hour. This mixture is then heated, with stirring, for a period of time to insure that the gelatine is thoroughly dissolved.

FILLING cans is a hand operation. An assembly line system may be used by placing the approximate weight of tongue into each can by hand and conveying the cans to check weighers to adjust the weight, or by weighing the tongues in pans and conveying them to fillers. The fillers then place the weighed amount of tongue into each can. The fill is then completed by adding the hot gelatin or agar into the cans by means of a ladle. Dry gelatin may be added to the smaller size cans.

It is desirable that the filled cans contain as many whole tongues and as few pieces as possible. Some packers prefer

Typical retort set-up. Man is operating controls on boom which carries crate into position for mechanical lowering.

to use an especially built press for placing tongues into 6 pound oblong cans in order to obtain a higher vacuum closure. It is also suggested that the tongues be packed warm because then they are soft and pliable.

Vacuum in the cans is obtained by means of a mechanical closure. A minimum machine vacuum of 20 inches or as high as possible, yet not producing excessive can distortion, is suggested. Inspection of the double seam for proper construction should be made at regular intervals.

CANS:—Use sanitary cans with 1.25 tin plate or 0.5 electrolytic with inside enamel. Glass is also used.

Can Size	Tongue	Jelly
404 x 200	11 oz.	1 oz.
502 x 201	17 "	1 "
502 x 207	21 "	2 "
502 x 213	25 "	2 "
502 x 303	28 "	3 "
502 x 309	32 "	3 "
502 x 408	44 "	4 "
603 x 700	93 "	5 "
310 x 402 x 808	44 "	4 "
310 x 402 x 1208	91 "	5 "

SPECIFIC EQUIPMENT:— Press for filling the cans.

PASTE TYPE MEAT PRODUCTS

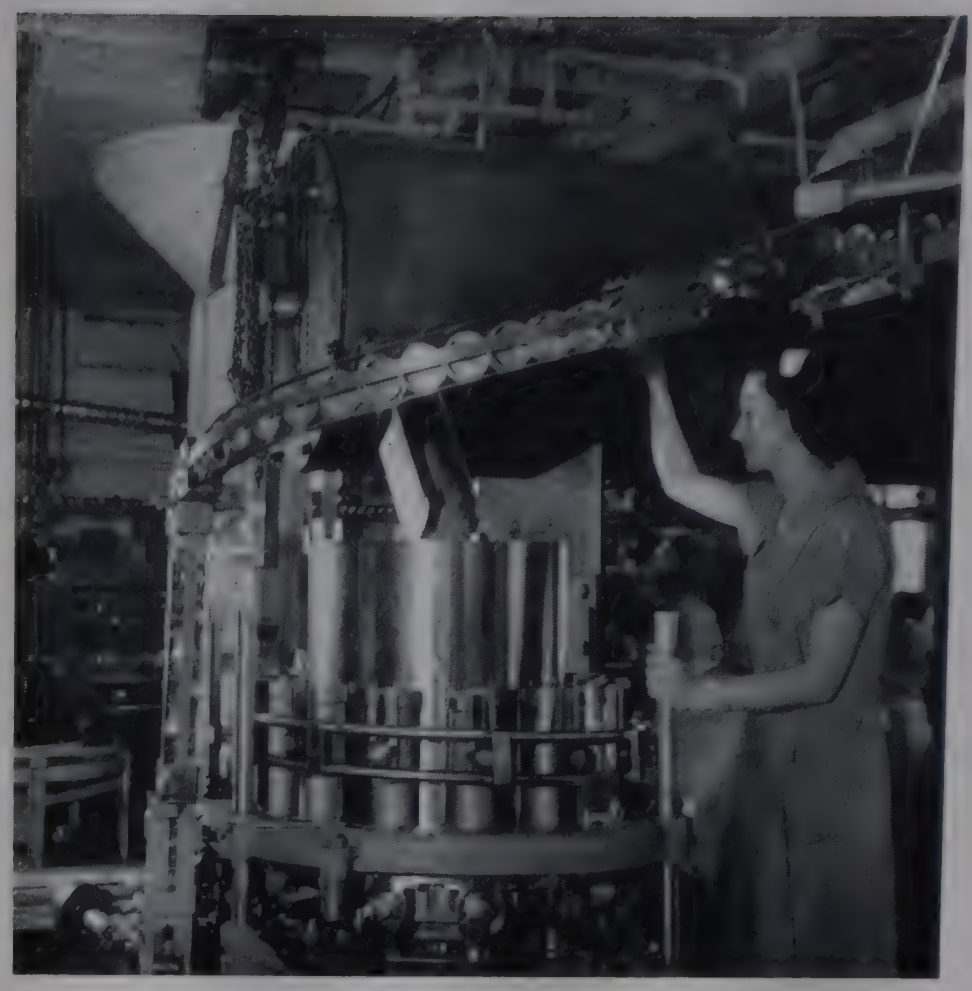
Various canned paste-type products may be prepared from meat, meat by-products and meat food products such as potted meats, sandwich spreads, deviled meats, puddings and pastes. Pungent spices are added to make the product "hotter". Binders are also used to a limited extent. The canning procedure for this group of products is the same, although each product is different with respect to amount and type of ingredients. The formulae used are dependent to some extent on the materials which are economically available.

Requirements of canned paste-type meat products as set forth by the Meat Inspection Division are as follows: "When cereal, vegetable starch, flour, dried milk, or the like are added to a product, the label must state 'cereal added', 'with cereal', as the case may be. . . Ham fat may be added to ham meat in the preparation of deviled ham provided the finished product does not contain more than 35% fat. . . The moisture content of deviled ham shall not exceed that of fresh unprocessed ham. . . The word 'ham' shall be used on labels only in conjunction with a chopped product, it shall not include the skin. . . Liver paste, liver pudding, and the like shall contain not less than 30% of liver computed on the weight of the fresh liver."

RAW MATERIALS listed in this formula should be of good commercial grade and purchased from Federally inspected plants.

PREPARATION:—The meat for canning specified in the formula should be well chilled, boned, and properly trimmed. It is cut into approximately two inch pieces by hand, rotary disc cutter, or by means of a chopper of the Enterprise type. A refrigerated cutting room is advisable if the meat is to be cut by hand. The fresh or cured meat materials should be parboiled separately until tender by immersing in boiling water and simmering for approximately 30 minutes, depending on the size, quality and type. The meat should be stirred during parboiling to obtain uniform heating. Paste-type products made from parboiled meats have a finer consistency and spread more uniformly. The meat may be held during parboiling in wire baskets or crates, which can be handled easily by a small crane.

Livers should be carefully trimmed to eliminate the bile vesicle or any portions which may have been contaminated by the bile. The livers may be used either raw or scalded. They may be leached for a short time in cold 20 salometer salt



This piston filler is filling potted meat into cans at 325 cans per minute. Tank in background stores and pre-heats meat.

pickle after having made several incisions lengthwise.

The precooked meat should be ground in a chopper of the Enterprise type having a ¾ inch plate.

The precooked, coarsely ground meats are chopped for approximately 5-8 minutes to a smooth paste in a silent cutter. The seasoning ingredients are thoroughly mixed in the product during this operation. A water emulsion of spice oils is suggested for convenience and uniformity of flavor.

Broth or water is added during this chopping operation to give the product the desired consistency. The amount of broth to be added cannot be standardized since the trimmings and by-products generally used vary in their absorptive power and the formulae are flexible to utilize the meat available. Judgment of the quantity to be incorporated to maintain a uniform consistency is a matter of experience.

If a binder is desired, it should be added as a thin paste during chopping in the silent cutter. Three to five pounds is generally added to each 100 pounds of meat. A process-type flour having properties of absorbing cold water may be added dry to permit easier judging of the final consistency and the amount of added broth required.

Most packers prefer to add sodium nitrite to the product when fresh meats are used. The cure may be conveniently prepared by dissolving 50 ounces of sodium nitrite in 50 gallons of water. One quart of this solution containing ¼ ounce of sodium nitrite is added to each 100 pounds of meat during chopping in the silent cutter.

If cooked tripe is used in the formula, it should be soaked overnight in a solution composed of four gallons of 100 grain vinegar to 96 gallons of water. This treatment is for the purpose of suppressing the formation of black iron sulfide which commonly occurs on the cooked tripe.

FILLING:—The product may be heated in a steam jacketed kettle just prior to filling. This operation is usually accomplished on an automatic type paste filler.

It is preferable to obtain vacuum in the cans by filling finely chopped meats at a minimum closing temperature of 160°F. Vacuum closure or steaming device closure is not suggested as the cans usually are filled completely. Lack of vacuum generally does not cause buckles in the smaller sizes,

but there is a noticeable tendency toward interior corrosion in low vacuum cans of paste-type meat products.

Deviled Ham

Cured meat and trimmings*	300 lbs.
Ground mustard	3 lbs.
Ground white pepper	9 ozs.
Ground red pepper	1.5 ozs.

Mace, nutmeg, and salt to taste

* Lightly smoked ham may be used to impart a smoked flavor to the product.

Deviled Tongue

Cured meat and trimmings	300 lbs.
Ground mustard	12 ozs.
Ground white pepper	9 ozs.
Cayenne pepper	3 ozs.

Mace, nutmeg, and salt to taste

Deviled Ham Sandwich Spread

The following formula may be used as a starting point and varied to suit the individual tastes or conditions:

Ham, parboiled	200 lbs.
Ground mustard	3 lbs.
Ground white pepper	½ lb.
Ground red pepper	1 oz.

Mace, cloves, and nutmeg to taste

It is usually necessary to add water so that the desired consistency is obtained.

Pate de Foie Gras

Pork or goose livers	50 lbs.
Pork trimmings	25 lbs.
Pork or goose fat	20 lbs.
Fried onions or mushrooms	5 lbs.
Salt	1 lb.
Ground mustard	1 oz.
Ground nutmeg	1 oz.
Ground cloves	1 oz.
Ground bay leaves	1 oz.
Ground marjoram	1 oz.

Chicken Sandwich Spread

Meat	100 lbs.
Skins	100 lbs.
Broth	50 lbs.
Gizzards	23 lbs.
Hearts	22 lbs.
Salt	3 lbs.
Fried onions	2 lbs.
Sodium nitrite solution	3 qts*
Ground white pepper	6 ozs.
Ground cloves	3 ozs.
Ground mace	3 ozs.

* (¾ oz. Nitrite)

Liver Spread

Pork livers	175 lbs.
Pork trimmings	75 lbs.
Tripe	25 lbs.
Processed flour	15 lbs.
Salt	6 lbs.
Ground white pepper	1 lb.
Ground mace	6 ozs.
Ground marjoram	3 ozs.
Ground cloves	1.5 ozs.

Pork Pudding

Livers	25 lbs.
Hearts	25 lbs.
Kidneys	25 lbs.
Head meat trimmings	25 lbs.
Skins	10 lbs.
Salt	3 lbs.
Ground white pepper	3 ozs.
Ground marjoram	2 ozs.
Ground nutmeg	2 ozs.
Ground allspice	2 ozs.
Ground ginger	1 oz.

When cured meats are incorporated into the formula, allowance should be made in the amount of salt and sodium nitrite added.

Tag on retort crate handle in photo below is used to check accuracy of process. It bears a color spot which is chemically constituted to change color when predetermined conditions ofheat, time and pressure have been met. Thus it checks product.

Potted Meat

Beef	75 lbs.
Tripe	60 lbs.
Beef head meat	45 lbs.
Beef hearts	40 lbs.
Pork trimmings	50 lbs.
Pork tongue trimmings	30 lbs.
Salt	3 lbs.
Ground white pepper	12 ozs.
Mustard	3 ozs.
Paprika	3 ozs.
Nutmeg	1 oz.
Sodium nitrite solution	3 qts.*

* (¾ oz. Nitrite)

Ham Spreads

Cured ham and trimmings	300 lbs.
Ground white pepper	9 ozs.
Coriander	3 ozs.
Mace	3 ozs.
Marjoram	3 ozs.

Veal Loaf

Veal loaf is made from veal and pork trimmings. Only fresh trimmings should be used. The following formula may be used as a starting point and varied to suit the individual tastes and conditions.

Boneless veal, parboiled	100 lbs.
Extra lean pork trimmings, parboiled	40 lbs.
Reasonably lean pork trimmings, parboiled	10 lbs.
Salt	3 lbs.
Peeled onions, hashed, or equivalent amount of powdered dried onion	2 lbs.
Ground white pepper	5 ozs.
Ground nutmeg	2 ozs.
Rubbed sage	1 oz.

CAN SIZES usually used:

Can size	Net weight
208 x 109	3 ounces
300 x 102	3 ounces
300 x 106	4 ounces
208 x 208	5 ounces
307 x 112	6 ounces
404 x 115	12 ounces

All products containing liver, pork or chicken should be packed in cans with inside enamel.

SPECIFIC EQUIPMENT:—Automatic high speed filler.

SUGGESTED HEAT TREATMENT FOR CANNED MEAT AND POULTRY ITEMS.

Product	Can Size	Weight lbs.	Weight oz.	Initial Temp. F.	Type	Processing time in minutes at 240 F.	Processing time in minutes at 250 F.
Corned Beef	404 x 202		12	100		85	60
	115 x 312 x 310		12	100		85	
	313 x 600 x 802	6		100		225	190
	410 x 414 x 804	6		100		245	200
	603 x 700	6	12	100		270	
Corned Beef Hash	300 x 409	1		140		85	
Luncheon Meat	300 x 308		12	38		65	
	115 x 312 x 310		12	38		85	
	310 x 402 x 1208	6		38		185	
	314 x 402 x 1200	6		38		210	
Hamburger	300 x 200		5¾	70	with or without gravy	80	55
	300 x 200		5¾	140		75	50
	300 x 407		15¼	70		120	95
	300 x 407		15¼	120		110	85
Beef and Pork Sausage Products	208 x 208		4	60	Frankfurters	45	30
	211 x 509		9	60		60	40
	300 x 409		12	60		85	60
	401 x 411	1	6	140		75	
	208 x 208		4	70	Vienna Sausage	30	
	211 x 400		9	70	" "	40	
	401 x 411	1	8	70	" "	90	
	603 x 700	5		70	ends and pieces	60	
Pork Sausage Products	603 x 700	6		70	sausage in oil	85	
	404 x 414	2	2	38	solid meat	180	
	404 x 414	2		38	sausage links	130	
	300 x 200		5¾	140	sausage patties	75	50
	211 x 400		10	120		85	65
	211 x 400		10	160		75	55
Meat and Vegetable Stew	300 x 308		12	120		95	70
	300 x 308		12	160		85	60
	300 x 409	1		120		95	75
	300 x 409	1		160		85	65
	401 x 411	1	14	120		145	115
	401 x 411	1	14	160		130	100
	603 x 700	6	12	120		260	215
	603 x 700	6	12	160		225	180

(Continued on page 186)

Meat Balls and	404 x 414	2	2	80		160	135
Spaghetti	404 x 414	2	2	160		140	110
Meat and	300 x 308		12	120		95	70
Noodle Products	300 x 308		12	160		85	60
Beans with	300 x 308		12	80		105	80
Frankfurters, in Tomato Sauce	300 x 308		12	160		85	60
Ham and Lima Beans	300 x 308		12	70		70	50
Chili Con Carne	401 x 411	1	14	50		150	
	603 x 700	6	12	50		240	
Beef or Pork	404 x 200		12	70		65	
Tongues	404 x 510	2	8	80		155	
	603 x 700	6	8	70		235	
	310 x 402 x 1204	6		80		155	
Paste Type	208 x 109		3	120		60	35
Meat Products	300 x 106		4	70		65	45
	300 x 106		4	120		60	40
	307 x 112		6	120		70	40
	404 x 115		12	120		90	60
Bacon: Pasteurization treatment for bacon	202 x 509		8	50	Sliced	165°F	
	307 x 509	1	8	50	"	135	
Beef, veal or	404 x 200		12	100		85	60
mutton	300 x 409	1		100		105	80
products	307 x 409	1	4	100		125	100
	603 x 700	5	12	100		280	
	313 x 600 x 802	6		100		210	195
	410 x 414 x 804	6		100		255	205
Beef and gravy	300 x 409	1		50	unbraised	100	75
or	300 x 409	1		150	braised	100	75
Pork and gravy	303 x 406	1		50	unbraised	105	80
	307 x 409	1	4	50	unbraised	120	95
	307 x 409	1	4	150	braised	120	95
	404 x 404	1	14	50	unbraised	150	120
	404 x 404	1	14	150	braised	150	110
	404 x 414	2	2	50	unbraised	165	130
	404 x 414	2	2	120	braised	160	125
Chicken	300 x 106		4	70	with little broth	60	40
products	300 x 106		4	140	" " "	55	35
	404 x 414	2	2	70	" " "	150	115
	404 x 414	2	2	140	" " "	130	105
	211 x 300		2⅛	160	chicken a la king		50
	211 x 414		4	160	" "		60

Inadequate doorway blocking after carloading may bring result shown at left. Cases of canned or glass-packed foods slip into doorway.

Here is resultant damage. When door is opened, cases are ripped, labels torn and cans dented. Loose loading and bad bracing cause 20% of damage to canned foods in railroad cars.

Section 6—Processing Meat and Poultry Products

Chapter II—Canning of Poultry

LIQUID and/or frozen eggs are used in canned meats. Because of a more uniform supply and sometimes a price advantage, frozen eggs are used more often than liquid eggs. Frozen eggs are usually packed in large, metal cans containing about thirty pounds. To remove frozen eggs from the can, the containers may be immersed in hot water or sprayed with steam. As soon as the frozen product is free from the sides of the can it should be dumped onto a screen placed over a meat truck. Frozen blocks of eggs should then be broken up and immediately placed into a grinder or chopper. Finely ground semi-solid eggs are then ready for use in a canned meat product. In order to obtain a more pleasing appearance in a canned meat product the eggs are usually placed in the can raw and the sterilization process cooks them.

Fresh or frozen New York dressed chickens and turkeys are usually used in canned meat products. New York dressed poultry is purchased in a frozen state. The thawing of the birds is accomplished by placing them in a tank of water, the temperature of the water not to exceed 65° F. They should never be defrosted by immersing in hot water. After thawing the birds are eviscerated. This must be done very carefully to avoid contamination of the poultry by bile leaking from a ruptured gall bladder or by the intestinal contents which is heavily contaminated with micro organisms. If necessary, the birds should be singed either by passing over a gas flame one at a time or, in a mass operation, on specially designed equipment. After singeing they should be washed with cold water. The next step is to place the birds in a large steam-jacketed kettle, covering them with water and cooking long enough to permit easy removal of the meat from the bone. Instead of using fresh water for each batch it is preferable to use the stock from the preceeding batch up to a fourth time. Overcooking must be avoided as it impairs the flavor and the texture of the flesh.

Boning is accomplished by picking the meat carefully from the bones in as large pieces as possible. Because of the size of the bird, even in the case of large turkeys, it is impractical to bone raw poultry.

Three separate piles should be made of the boned meat, one containing dark meat, one white meat and another the skin. Skin that is pigmented, bruised or contains pin feathers, feather particles or hair should not be used. The skin should be ground into pieces not over ⅛ inch in size. Light and dark pieces of meat should be used in whatever proportion is best suited for the canned meat product being manufactured. All of the skin is not usually used. About 10% of the finished product should consist of skin. If more is used an undesirable appearance may be obtained. The remainder of the skin may be used in such products as chicken and noodles. Many formulas call for the addition of chicken fat. This fat may be obtained from the stock in which the chicken was cooked or by rendering the leaf fat of the chicken.

Broth when used in canning chicken is usually used as a topping off procedure. It will add some flavor over that which would be obtained if tap water was used. If broth is added it should be held at a temperature of at least 160° F. The broth should be obtained by cooking at least two batches but not more than four batches of poultry. If more than four batches are cooked in the broth a bitter flavor may result in the finished product.

CANNING OF CHICKEN AND CHICKEN PRODUCTS

Many different canned products may be prepared from chickens such as, whole chickens, half chickens, boneless chicken in jelly, stewed chicken, roast chicken, chicken fricasse, chicken a la king, chicken and noodles, diced chicken, chicken soup, potted chicken, and chicken spread. In order to prevent waste, several of the above products may be prepared from different portions of the chickens. For example, the better portions could be used for boneless chicken in jelly or stewed chicken; the smaller pieces for chicken a la king or chicken and noodles; the gizzards and hearts for chicken giblets; and the broth, obtained from precooking the chickens and cooking the bones for chicken soup. Otherwise only one product may be packed using the chicken meat and broth in its preparation.

The formulae and methods used in preparing these products vary greatly and depend on the quality of the product desired and the tastes of the packer and consumer.

The only federal regulations applicable to poultry products are those promulgated by the Pure Food, Drug and Cosmetic Act.

The class of poultry known as fowl is usually used in canned poultry products. About 10-12% of stags or cocks may be used without serious deterioration of the quality of the finished product.

Chickens fattened into prime condition are preferable for canning, as a better flavored product is obtained. It is desirable to handle birds of similar quality in batches so that uniform procedures, such as precooking, may be employed.

Old hen turkeys are usually used for canning. A 10% tolerance of other turkey types will not seriously effect the quality of the end product. All poultry should be sound, reasonably well fleshed and show no evidence of a poor condition or disease. Frozen poultry may be used providing it shows no evidence of deterioration, defrosting or refreezing.

The best quality of finished product can be made from grades A and B chicken or turkey.

PRECOOKING:—The chickens may be precooked whole or after they are cut in pieces, in boiling water, steaming, or by roasting. The method used for precooking depends on the purpose of the operation. To obtain well flavored chicken meat, the chickens should be plunged into sufficient boiling water to merely cover them, the water brought to a boil and allowed to simmer until the chicken meat is sufficiently tender to easily remove from the bones. For a good quality broth, the chickens are covered with cold water which is slowly brought to a boil, and allowed to simmer until broth of the maximum strength is obtained. The time required in the precooking process depends on the size and quality of the birds. Some packers prefer to precook the chickens in water under pressure at 240°-250° F. This procedure shortens the time required for precooking. The chickens are usually placed in perforated crates or cages for precooking so that they can be easily removed from the broth.

Where chicken meat of good quality is desired, and large amounts of broth are not needed, successive charges of chickens may be precooked in the same broth. Otherwise more broth accumulates than is needed for the product. This broth may be evaporated down to the volume needed or a part of the broth may be used for the chicken product and the remainder canned as chicken broth. When chickens are precooked in water it is desirable to remove the scum which forms on the surface of the broth.

The practice of precooking chickens in steam is more suitable for those products which do not require long cooking. The chickens are placed in cans or drums [illegible] and cooked in steam, usually [illegible] precooking in water. The broth which cooks out is collected in the cans or drums.

For roasting, the chickens or pieces of chicken such as legs, thighs, and breasts, may be rubbed with a mixture of salt, pepper, and paprika and roasted in ovens until the meat is sufficiently tender to be removed from the bones. If desired the chicken may be pre-steamed to shorten the time of roasting. The juices that cook out during roasting is saved and usually used for preparing gravy.

The giblets are precooked separately. It is advisable not to cook the livers with the chicken as they may impart an off-flavor to the rest of the chicken. Livers should not be canned for the same reason. They are generally chilled or frozen and sold fresh.

The chicken should not come in contact with copper or iron equipment as contact with these metals may result in black discoloration of the canned product. Satisfactory results are obtained with stainless steel and aluminum equipment. Galvanized iron is satisfactory, but may cause discoloration if the galvanizing wears off in spots.

In the canning of chicken and chicken products it is desirable to fill the cans to within ¼ inch of the top of the cans and to secure a high closing temperature, at least 160° F. and preferably higher, to minimize interior discoloration of the cans.

The canning operation should be carried out to secure a continuous flow of the product. During breakdowns or long shutdowns, the product should be stored under refrigeration or under conditions which insure rapid cooling. Chicken broth is a very perishable item and rapidly looses its good flavor even when stored under refrigeration.

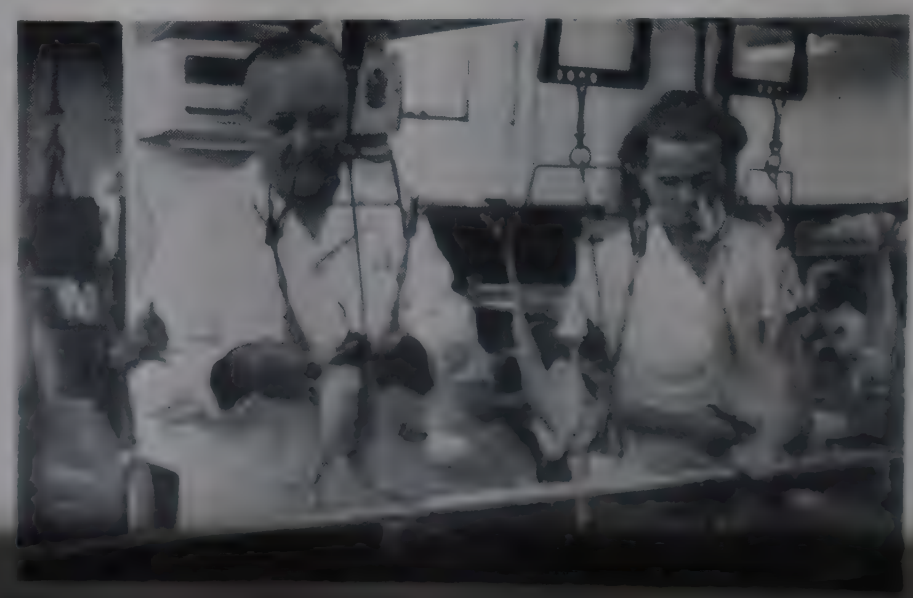
The bones, skins, legs, and other edible portions of the chickens which may not be used in the canned product may be precooked for chicken broth. The materials are usually covered with water, which is brought to a boil and allowed to steam for several hours, usually overnight. This broth does not have as good flavor as that obtained from cooking the chickens. The flavor may be improved by concentration of the broth. Frequently, it is concentrated and mixed with the broth obtained from precooking the chickens.

CANS:—Either plain cans or cans with inside C-enamel may be used for chicken or chicken products.

BONELESS CHICKEN IN JELLY

The larger pieces of boneless chicken prepared as above are generally used for this product. Sufficient chicken should be added to the cans so that the canned product contains at least 65% by weight of chicken flesh. It is desirable to have the cans well filled with chicken meat.

Chicken eviscerating line. Man is Federal inspector. Care prevents contamination by bile or bacteria infesting the viscera



Frozen chicken being conveyed past heater which singes pinfeathers and warms chicken. Do not defrost with hot water.

The fill of the can is completed with jelly at or near the boiling point, generally prepared from the broth obtained when the chickens are precooked. This broth may be concentrated as desired or used without concentration. To secure a clear jelly the broth should be filtered. The jelly may be prepared according to the desires of the manufacturer with respect to seasoning and jelly strength. A basic formula follows:

10 gallons broth
3¾ pounds salt
7½ ounces ground white pepper
10 pounds gelatin of good grade
or 20 pounds of agar

The gelatine or agar should be soaked in cold water at least 1 hour before adding to the broth. The salt may be added directly to the can instead of in the jelly if this is preferred.

The following can sizes and net weights are used:

Can size	Net Weight
211 x 108	3 oz.
307 x 112	6 oz.
211 x 300	7¾ oz.
307 x 200	8 oz.
404 x 115	12 oz.
401 x 211	16 oz.
307 x 409	20 oz.
404 x 304	24 oz.

STEWED CHICKEN

Stewed chicken is prepared and canned in a similar manner to that described for boneless chicken. A gravy is used to complete the fill of the can. This may be seasoned according to the desires of the canner. The following basic formula is suggested:

10 gallons broth
3¾ pounds salt
7½ ounces white pepper
2½ pounds flour made into a smooth paste with
cold water

The same can sizes, fill-in weights, and processes suggested for boneless chicken are also used for stewed chicken.

ROAST CHICKEN

The large pieces of meat obtained from precooking by roasting as described above are filled in cans of the sizes given under boneless chicken. The cans are filled with a hot gelatine solution or gravy prepared from the liquid obtained when the chickens were roasted. The net weight and processes are the same as previously given for boneless chicken in jelly.

CHICKEN FRICASSEE

For this product, the chickens are cut into pieces which will fit the size of the can in which they will be packed, prior to precooking. Each can should contain pieces of light and dark meat. Also, each can should be packed with both the more desirable pieces such as breasts, thighs, and legs, and the less desirable pieces such as backs, necks, and wings. Hearts and gizzards may also be used in this product.

The fill of the can is completed with a gravy prepared similarly to that mentioned under stewed chicken, although a portion of the chicken broth may be replaced with milk.

The following can sizes and net weights are suggested:

Can Sizes	Net Weight
307 x 409	20 oz.
401 x 411	29 oz.

The processed cans should be promptly cooled in water to prevent overcooking.

CHICKEN IN PIECES

The canning procedure for chicken in pieces is similar to that for chicken fricassee, except that a jelly, such as described for boneless chicken in jelly, instead of a gravy, is used. This product may also be canned using chicken broth seasoned with salt, pepper, and other ingredients as desired, instead of a gravy or jelly. The can sizes, net weights, and processes are the same as those given for chicken fricassee.

CHICKEN A LA KING

Canned chicken a la king consists, generally, of boneless chicken meat, mushrooms, green peppers, pimentos, celery, peas and a sauce.

Spicing and consistency of the sauce depend on the individual tastes or demands of the trade. The following is a basic formula:

Sauce

Chicken broth	52	gallons
Milk	39	gallons
Wheat flour	42	gallons
Corn starch	6	pounds
Corn oil	33	pounds
Salt	11	pounds
Di-sodium phosphate	1.5	pound
White pepper	1.4	ounce

Solid Ingredients

Chicken meat	62	pounds
Chicken skins	31	pounds
Mushrooms	55	pounds
Celery	26	pounds
Green peppers	31	pounds
Pimentos	33	pounds
Peas (3 or 4 sieve Alaskas)	66	pounds

PREPARATION OF SAUCE:—In preparing the sauce, the wheat flour, corn starch, corn oil, salt, di-sodium phosphate, and white pepper should be mixed with a portion of the cold broth or water to make a smooth paste. The paste is gradually diluted by adding the chicken broth and the milk with constant stirring. The sauce is brought to a boil and is then ready for mixing with the vegetables, chicken meat and skins. A hydrogenated fat may be substituted in place of the corn oil. Locust bean gum may be used to obtain the desired consist-

ency of the sauce. It is advisable to use flour with a low thermophilic bacteria content.

PREPARATION OF SOLID INGREDIENTS:—In preparing the solid ingredients, the boneless meat secured by grading at the boning table, is diced into approximately ½ inch pieces. The skins taken from the boning operation are ground through a ⅛ inch plate. The cleaned and trimmed mushrooms, green peppers, pimentos and celery are diced into approximately ¼ inch pieces. The diced mushrooms should be added to the sauce immediately to prevent darkening due to exposure to air. Otherwise the diced mushrooms should be held under cold water. Raw peas should be blanched about 10 minutes. If canned peas are used the brine should be drained off prior to adding the peas to the sauce.

Some packers prefer to add the sauce and the solid ingredients (30% of total weight of contents) separately to each can, the reason being that the solid materials tend to separate in the sauce resulting in a mixture that is not uniform. The amount of separation will depend largely on the consistency of the sauce.

There should be no delay in placing the sealed cans in the retorts and starting the process. A list of general can sizes follows:

Can Size	Net Weight
211 x 300	8 ounces
211 x 400	11 ounces
211 x 414	13.5 ounces

CHICKEN AND NOODLES

Chicken and noodles consists of chicken meat, noodles, and chicken broth. The chicken meat is prepared as above and may consist of the smaller pieces selected from the boning table. The broth is prepared from that secured during the precooking by adding 3¾ ounces of ground white pepper to each 10 gallons of broth. Good quality egg noodles should be used for this product. These should not become starchy and gummy after processing.

The following ratio of ingredients may be used as a starting point and varied as desired:

25% chicken meat
25% dry noodles
50% broth

The meat and noodles are added together and the fill of the cans completed with boiling broth.

PREPARATION:—The chicken should be prepared as outlined under chicken products.

Materials	Pounds	Ounces
Cooked noodles	50	
Cooked chicken meat	46	
Raw onions		4½
Salt	1	6
Black pepper, ground		⅛

FILLING:—When the noodles are cooked, and flushed with cold water, they should be placed in a mechanical mixer and thoroughly mixed with the chicken meat and other ingredients. The mixture should then be filled into cans with semi or automatic equipment. A thermal or mechanical exhaust may be used.

PROCESSING:— A process of 45 minutes at 240° F., or 25 minutes at 250° F. is used for No. 1 cans for this product. The processed cans should be promptly cooled in water to attain an average temperature of the contents of 105° F. to prevent thermophilic spoilage and overcooking of the product. These processes apply only when dried noodles are used. When canned noodles are used, longer processes are required.

DICED CHICKEN

The [illegible] for this product generally consists of the [illegible] table. This meat is diced or ground to the desired size. Approximately 25% of finely ground chicken skins may be mixed with the chicken meat. The following is a typical formula for the product which may be varied as desired:

75 pounds chicken meat
25 pounds finely ground chicken skins
2½ pounds salt
2½ gallons chicken broth
4 pounds corn starch mixed to a thin paste with the chicken broth.

The filled cans are heat exhausted to give the contents an average temperature of at least 160° F.

CHICKEN SANDWICH SPREAD

This product consists of finely ground chicken meat, seasoned with spices, to which the broth is added to give the desired consistency. Chicken skins may be added to the meat if desired.

The following formula may be used and varied as desirable:

80 pounds chicken meat and skins
2 pounds onions
2 pounds salt
1 ounce ground white pepper
1 ounce ground cloves
1 ounce ground mace
1 gallon chicken broth

In addition, 4 pounds of flour may be added, if desired.

The meat is usually finely ground in a silent cutter, and during this operation the other ingredients are added. The product may be filled into cans by an automatic filling machine. It should be preheated or the filled cans exhausted so

After carcasses are cleaned with pressure hose, necks and feet are removed, as shown here. Then birds get a hot water bath.

Sterilized containers and completely cleaned chickens arrive at filling station. Seasonings and broth are added here.

that a closing temperature of not less than 160° F. is attained.

The following can sizes and net weights are suggested:

Can Size	Net Weight
300 x 102	3 ounces
300 x 107	3 ounces
208 x 109	3½ ounces
208 x 208	5 ounces

DEVILED CHICKEN

This product is similar to chicken spread and differs only in the spicing, in that 8 ounces of mustard would be added to the formula for chicken sandwich spread.

POTTED CHICKEN

This product is prepared in the same manner and with the same canning procedures described for chicken sandwich spread. The chicken meat frequently used in this product is obtained from chickens which have been thoroughly extracted for the preparation of high grade chicken broth as previously described. To this meat, the chicken skins and approximately 10% salt pork may be added. The following typical formula may be varied as desired:

90	pounds chicken meat and skins
10	pounds salt pork
5	pounds of onions, sliced
4	pounds of salt
1	pound of celery
½	pound of ground white pepper
¼	pound of whole cloves
2	ounces of mace
1	ounce of bay leaves

Potted chicken is generally canned in 208 x 109 cans containing 3½ ounces and in 208 x 208 containing 5 ounces of the product. The processes are the same as suggested for chicken sandwich spread. The processed cans should be promptly cooled in water to an average temperature of 105° F. to avoid thermophilic spoilage and overcooking.

CANNING OF WHOLE SMALL CHICKENS

Whole chickens of small size may be packed in No. 2½ or No. 3 cans using the following method:

The drawn chicken is washed in cool water to remove blood and serum. If the former is not removed the appearance of the chicken is poor while the latter coagulates and causes a cloudy jelly which is unattractive.

PACKING:—The giblets are stuffed into the cavity formed by drawing the chicken. The chicken is then inserted tightly into the can and covered with a hot solution of boiling water containing 2% salt, or with a hot solution made by dissolving gelatine of a good commercial grade in cold water. This solution should contain 5-10% gelatine. The gelatine is used to cause the entire contents of the can to solidify after the product has been cooled. It is preferable to add a portion of the boiling hot brine solution or a portion of the gelatine into the container, since the chicken fits so tightly into the can that the liquid may not flow to the bottom of the can.

The can and contents should then be exhausted either in steam or hot water before closing. The exhaust necessary will be 10-12 minutes. The cans should be cooled promptly after processing in cold water.

CHICKEN GIBLETS

Chicken giblets for canning should not include chicken livers, as these may impart an off flavor to the product during precooking and canning. The giblets are precooked and canned in chicken broth or in a gravy as was described for stewed chicken. The cooked giblets are placed in the can and the fill of the can completed with gravy or broth at or near boiling. With the use of boiling broth or gravy it is rarely necessary to exhaust No. 1 cans of chicken giblets.

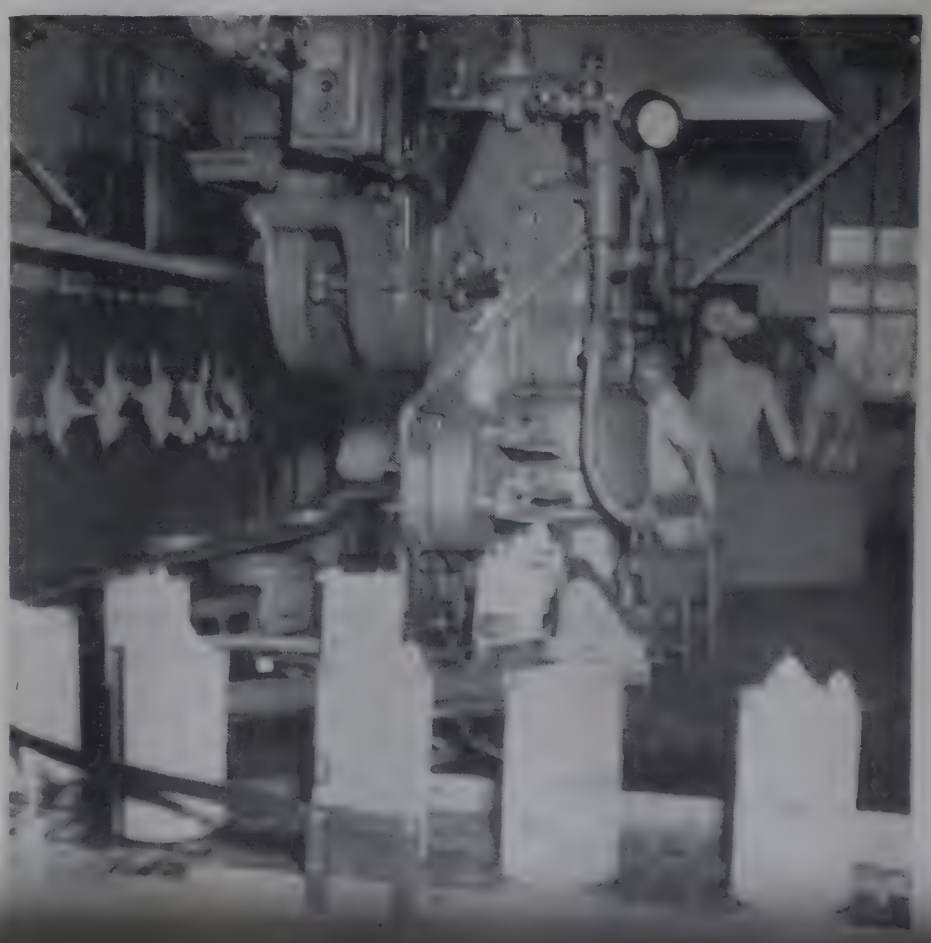
The processed cans should be cooled promptly in water.

CHICKEN FAT

The rendered chicken fat should be clarified to remove all solids and traces of moisture. This may be done by filtration and heating. The removal of the moisture is important as otherwise rancidity, souring, and off-flavors may develop in the chicken fat.

The clear, moisture-free chicken fat is filled into cans at 170°-180° F. leaving headspace of about ¼ inch. The cans are hermetically sealed and no processing is required.

Cans of whole chicken are being sealed and inspected in this photo. During long shutdowns of processing lines, unpacked chickens should be refrigerated until production is resumed.



A typical scene in a canner's quality control laboratory.

Section 7—Quality Control

Procedures

ALCOHOL—BY DISTILLATION

For analysis by distillation, pipette 100 cc. of the sample into an 800 cc. Kjeldahl flask and add 50 cc. of distilled water. Connect to a condenser and distill about 87 cc. into a 100 cc. volumetric flask. Bring the flask to 68° F. (20° C.) and make the volume up to the mark with distilled water. Shake and bring to 68° again. Empty the alcohol into a cylinder and float an alcohol hydrometer in it. Be sure that the hydrometer is clean and dry and do not touch it except at the top. Carefully make a reading and then take the temperature of the solution. Correct the reading by reference to Table I. (If the hydrometers are calibrated at some other temperature, a different table will be necessary).

CUT-OUT WEIGHTS

A.O.A.C.—Weigh full can, open, pour entire contents on round sieve screen. Without shifting product, so incline sieve as to facilitate drainage of liquid. Use sieve 8 inches in diameter for No. 3 or smaller can, and sieve 12 inches in diameter for cans larger than No. 3.

Allow material on sieve to drain 2 minutes, weigh the sieve and drained fruit. The weight so found, less the weight of the sieve, shall be considered to be the total weight of drained fruit.

EGG YOLK IN MAYONNAISE

TOTAL NITROGEN:—(A.O.A.C.) Weigh about 15 grams of the sample into 500 ml. Kjeldahl flask and place on steam bath until egg is thoroughly cooked and oil separates readily. Cool, and add about 50 ml. of petroleum benzine; mix, pour off benzine solution through small filter. Repeat benzine treatment twice, rinsing out as much oil as possible. Wash filter with petroleum benzine and add filter paper to sample in flask.

Determine N, using 35 ml. of H_2SO_4 for digestion as follows: Place 0.7-3.5 g. according to N content of material to be analyzed in a digestion flask. Add 15-18 g. of K_2SO_4 or substitute Na_2SO_4, 1 g. of $CuSO_4$ or about 0.7 g. of HgO and 25 ml. of the H_2SO_4. Heat mixture gently until frothing ceases, then boil briskly and continue digestion for a time after mixture is colorless or nearly so, or until oxidation is complete (about 2 hours). Cool, add about 200 ml. of H_2O and if HgO or metallic Hg has been used, add also 50 ml. of the K_2S or Na_2S or $Na_2S_2O_3$ solution. Make strongly alkaline with the NaOH solution (about 50 ml.), pouring it down side of flask so that it does not mix at once with the acid solution. Connect flask to condenser by means of Kjeldahl connecting bulb, taking care that the tip of the condenser extends below surface of the standard acid in the receiver; mix contents by shaking and distill until all NH_3 has passed over into a measured quantity of the standard acid. (First 150 ml. of distillate generally contains all the NH_3). Titrate with standard alkali solution, using the methyl red or cochineal indicator.

TOTAL PHOSPHORIC ACID:—Weigh 10 g. sample into platinum dish. Add 20 ml. of 10% Na_2CO_3 solution and evaporate to dryness on electric hot plate or overnght at 100-105°. Burn off oil and transfer while hot to electric muffler heated to 500° (faint redness), and allow it to remain at this temperature 1 hour. Cool, add a few drops of H_2O, break up charge with glass rod having flattened end, cover platinum dish with watch-glass, add slowly while stirring 10 ml. of HNO_3 (1 + 3), mix, wash watch-glass and filter, collecting filtrate in 300 or 500 ml. Erlenmeyer flask. Thoroughly wash charred material and filter with H_2O.

In the prepared filtrate determine P_2O_5 as follows: Use an aliquot corresponding to 0.1 g. of substance. Add 5-ml. of HNO_3, depending on method of solution (or equivalent in NH_4NO_3); add NH_4OH until precipitate that forms (dissolves slowly on stirring vigorously), dilute to 75—100 ml. and adjust to temperature of 25—30°. If the sample is of such nature that it will not give a precipitate with NH_4OH as a test of neutralization, make the solution slightly alkaline to litmus with NH_4OH and then slightly acid with dilute HNO_3. Add 40—50 ml. of molybdate solution. Place solution in shaking or stirring apparatus and shake or stir 30 minutes at room temperature; decant at once through filter, and wash precipitate twice by decantation with 25—30 ml. portions of H_2O, agitating thoroughly and allowing to settle. Transfer precipitate to filter and wash with cold H_2O until filtrate from 2 fillings of filter yields pink color upon addition of phenolphthalein and 1 drop of the standard alkali. Transfer precipitate and filter to the beaker or precipitating vessel, dissolve precipitate in small excess of the standard alkali and

a few drops of phenolphthalein indicator, and titrate with the standard acid. Report as total P_2O_5.

P=% total P_2O_5
N=% total N
% yolk=75.69 P—1.802 N

INSECT FRAGMENTS

A.O.A.C.—Grind representative sample twice through food chopper and mix thoroughly. Weigh about 200 grams (100 gm. in case of paste, mixed with 100 cc. water) of the material, into a Wildman trap flask with 20 ml. of castor oil and mix well. The extraction of the fragments depends upon their coming in contact with particles of oil, so thorough mixing at this point is essential. Violent shaking should be avoided as it tends to form an emulsion that is difficult to handle. Add warm tap water (about 50° C.) in such a manner as to agitate and mix the whole combination thoroughly until the flask is filled. Let stand with occasional gentle stirring for 30 minutes or until the oil has nearly all risen to the top. In this manner, the insect fragments are brought to the top with the castor oil. The castor oil and a shallow portion of the aqueous layer is then entrapped in the neck of the flask by raising the plunger until it fits snugly in the lower end of the flask neck.

The entrapped portion above the stopper is poured out into a beaker. Wash out neck of flask with alcohol to remove adhering castor oil. Add to flask a little more hot water, stir, let stand 10 minutes, and then trap off again to secure any fragments that may have escaped previous trapping. Filter trapped-off portion through quick action filter paper in a suction Buchner funnel, washing beaker, sides of funnel, and paper thoroughly with alcohol to dissolve oil and speed filtration. Examine paper microscopically at 20-30 diameters.

MOISTURE

WOODMAN METHOD, the most commonly employed for the determination of moisture in foods, is by drying at the temperature of boiling water.

A convenient weight, usually 2 to 10 grams is spread in a thin layer in a flat-bottomed dish or on a watch glass and dried in an oven surrounded by boiling water until the weight, at intervals of ½ hour, remains constant. The loss in weight is taken as water.

Electrically heated ovens are more commonly used if the temperature is to be varied from that of boiling water.

ELECTRIC AIR-OVEN METHOD:—A.O.A.C. official (not intended for use when subsequent fat determination is to be made on same sample).

Regulate electric air oven to 135°, ± 2°. Using low, covered aluminum dishes, weigh about 2 g. of sample into each aluminum dish and shake until contents are evenly distributed. With covers removed, place dishes and covers in oven as quickly as possible and dry samples for 2 hours. After placing covers on dishes transfer them to desiccator to cool. Weigh, and calculate loss in weight as moisture.

MOLD COUNT (HOWARD)

A.O.A.C.—Add mold-free gum to thin products and water to thick products from 8.37 to 9.37% of solids, taking account of salt or other substances materially increasing the solids content.

Clean the special Howard cell so that Newton's rings are produced between slide and cover glass. Remove cover and place small drop of the well mixed sample upon central disk; using knife blade or scalpel, spread drop evenly over disk and cover with the glass so as to give an even spread.

It is of the utmost importance that the drop be taken from a thoroughly mixed sample and spread evenly over the slide disk. Otherwise, when cover slip is put in place, the insoluble material, and consequently the molds, may be more abundant at center of mount. Avoid using a drop that is much greater than is sufficient to fill space between center disk and cover slip. Discard any mount showing uneven distribution, absence of Newton's rings, or liquid that has been drawn across moat and under cover glass.

Place slide under microscope and examine with such adjustment that each field of view covers 1.5 sq. mm. (This area of vital importance may frequently be obtained by so adjusting the draw-tube that the diameter of the field becomes 1.382 mm. When such adjustment is not possible, it is sometimes necessary to have a mechanic make an accessory drop-in ocular diaphragm with the aperture accurately cut to necessary size). The diameter of area for field of view can be determined by use of a stage micrometer. When instrument is properly adjusted, quantity of liquid examined per field is 0.15 cu. mm.

From each of two or more mounts examine at least 25 fields taken in such a manner as to be representative of all sections of the mount. Observe each field, noting presence or absence of mold filaments and recording result as positive or as negative, as case may be. No field should be considered positive unless the aggregate length of not more than three of the filaments present exceeds approximately ⅙ of diameter of field. Calculate proportion of positive fields from results of examination of all observed fields and report as percentage of fields containing mold filaments.

PECTIN

A.O.A.C—Weigh 300 g. of the thoroughly mixed sample into a 2 liter flask and dissolve in H_2O, heating on steam bath if necessary. Apply as little heat as possible to minimize inversion of sucrose. Cool, dilute to mark, and mix thoroughly by shaking. If insoluble material is present, mix thoroughly and filter.

Transfer 200 ml. aliquot of the prepared solution to beaker, add 8—12 gm. of sucrose if solution does not already contain sugar, and evaporate to about 25 ml. If organic acids are to be determined in filtrate from the pectin, cool, add 3 ml. of normal H_2SO_4, and immediately add with constant stirring 200 ml. of alcohol, all precipitate formed to settle, filter on 15 cm. qualitative paper, and wash with alcohol. If organic acids are not to be determined, omit addition of

Waring blender is used to blend fruit with liquid. Blend is then filtered and soluble solids is read on a refractometer.

H_2SO_4. Transfer precipitate to original beaker with hot H_2O, evaporate to about 40 ml., and cool to 25° or below. If water-insoluble matter separates during evaporation, stir vigorously, and if necessary, add a few drops of HCl (1 + 2.5) and warm; then cool again. Dilute 2—5 ml. of 10% NaOH solution, depending upon volume of the precipitate, to 50 ml., and add to solution of the alcohol precipitate. Allow to stand 15 minutes, add 40 ml. of H_2O and 10 ml. of HCl (1 + 2.5 and boil 5 minutes. Filter, and wash precipitate of pectic acid with hot H_2O. (This filtration should be rapid and the filtrate clear. If filtrate is cloudy or of colloidal nature, reject the determination. Colloidal filtrates are due to insufficient alkali or to saponification at too high a temperature, or both. In such cases, repeat determination, using more alkali and keeping temperature low).

Wash precipitate of pectic acid back into beaker, adjust to volume of 40 ml., cool to below 25°, and repeat the saponification with the dilute NaOH solution, the precipitation with the dilute HCl, and the boiling as above described. Again filter and wash precipitate of pectic acid with hot H_2O, but only to point where test of filtrate shows negligible quantity of acid. (Not more than 500 ml. of total filtrate should be necessary). Wash the pectic acid into platinum dish and dry on steam bath and finally in water oven to constant weight. Weigh, ignite, and weigh again. The loss in weight is pectic acid.

pH OR H-ion CONCENTRATION

ELECTROMETRIC METHOD:—(A.O.A.C.) Determine pH of sample being careful to follow instructions issued by manufacturer of potentiometer used. Check the pH meter before and after use against standard buffers (freshly prepared 0.05M sols of K acid phthalate serve well for standardization of potentiometers at pH 4.00).

COLORIMETRIC METHOD:—(A.O.A.C.) In absence of potentiometric equipment, follow colorimeteric procedure using bromocresol green as indicator.

SOLUBLE SOLIDS

BY MEANS OF ABBE REFRACTOMETER:—To charge instrument, open double prism by means of screw head and place a few drops of sample on prism or, if preferred, open prisms slightly by turning screw head and pour a few drops of sample into funnel-shaped aperture between prisms. Close prisms firmly by tightening screw head. Allow instrument to stand for a few minutes before reading is made, so that temperature of sample and instrument will be the same.

Method of measurement is based upon observing position of border line of total reflection in relation to the faces of a flint glass prism. Bring this border line into field of telescope vision by rotating the double prism by means of the alidade in following manner: Hold sector firmly and move alidade backward or forward until field of vision is divided into light and dark portion. Line dividing these portions is the "border line", and, as a rule, will not be a sharp line but a band of color. The colors are eliminated by rotating screw head of compensator until sharp, colorless line is obtained. Adjust border line so that it falls on point of intersection of cross hairs. Read refractive index of substance directly on scale of sector.

TOTAL ACIDITY

INDICATOR TITRATION METHOD:—A.O.A.C. Dilute 10 g. of the sample or 25 cc. of prepared juice with recently boiled water to about 250 cc. or less depending on the color of the sample. Titrate with 0.1N alkali, using phenolphthalein indicator with highly colored products use azolitmin solution or phenolphthalein powder on a spot plate. Report the result as cc. of 0.1N alkali per 100 g. or 100 cc. of the original material.

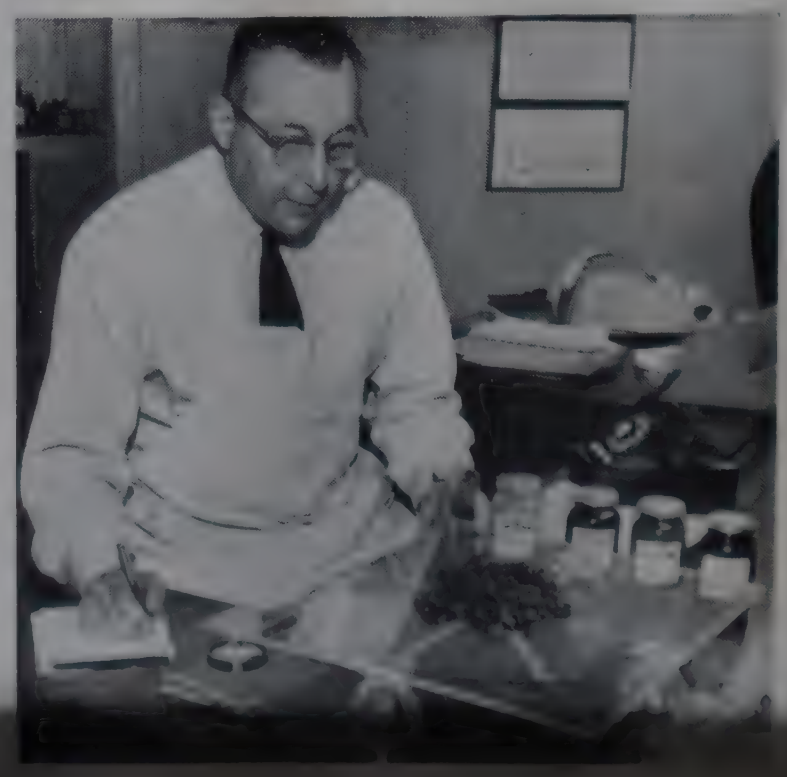
FOR VINEGAR AND PICKLES:—(A.O.A.C.) Dilute 10 ml. of sample with recently boiled and cooled H_2O until it appears slightly colored and titrate with 0.5N alkali (sodium hydroxide) using phenolphthalein indicator.

1 ml. of 0.5N alkali = 0.0300 g. of acetic acid

A.O.A.C.—Fill burette with standard sodium hydroxide (NaOH) solution (tenth normal). Accurately measure 10 cc. of sample into a beaker and add 5 to 6 drops of phenolphthalein indicator. Then slowly run in from the burette, after adjusting to zero, the NaOH solution while stirring, until the sample turns to a faint pink color for at least 10 seconds. This indicates completion of the test. Read the burette, and this reading is the cc. of solution required to neutralize the acidity of the sample. To calculate the percent of acetic acid, multiply burette reading by 0.006 x 10. The molecular weight of acetic acid is 60 and 1 cc. of tenth normal alkali exactly neutralizes 0.006 gms. of acetic acid.

Example: Suppose it required 12.8 cc. tenth normal NaOH

At left below, a grader examines quality of peas in a canner's quality control laboratory. At right, a "spreadmeter" is used to gauge the consistency of preserves. Concentric rings on a transparent plate index spread of product emptied for test.



to neutralize the acid in 10 cc. of the sample, then—

$12.8 \times 0.006 \times 10 = .768\%$ as acetic acid

SAUERKRAUT:—Determination of total acid (expressed as lactic) by titration with 0.1N NaOH. (Anchor Hocking Glass Corporation)

When making this titration, measure 10 cc. of the kraut brine into a flask and add a few drops of phenolphthalein. Admit 0.1N NaOH from a burette until a pink color develops in the brine. The pink color should not fade after standing 30 seconds. Each cc. of 0.1N NaOH is equivalent to 0.09% of the lactic acid in a 10 cc. sample of brine. Therefore, multiply the number of cc's of alkali used by 0.09 to determine percent of lactic acid in the sample of kraut brine.

Example: Suppose it requires 12.8 cc. tenth normal NaOH to neutralize the acid in 10 cc. brine, then—

$12.8 \times 0.09 = 1.152\%$ lactic acid

SPECIFIC GRAVITY

A.O.A.C.—Clean pycnometer by use of a chromate—H_2SO_4 solution and rinse thoroughly with H_2O.

Fill pycnometer above graduation mark with recently boiled H_2O, insert stopper, and immerse in constant temperature water bath maintained at desired temperature so that water level of both is above graduation mark on pycnometer. After 30 minutes remove stopper and by means of finely drawn out capillary tube adjust until bottom of meniscus is tangent to graduation mark. A hand lens aids in making adjustment.

With small roll of filter paper, dry inside neck of pycnometer above meniscus. Stopper and immerse in H_2O at room temperature for 15 minutes. Remove pycnometer, dry with clean lintless cloth, let stand 15 minutes and weigh. Empty, rinse several times with alcohol followed by ether, or several times with acetone, and dry thoroughly in air with suction. Allow empty flask to come to room temperature, stopper, and weigh. Ascertain weight in air of contained H_2O by subtracting weight of empty pycnometer from weight when filled.

Determination:

Obtain weight of sample as directed above. Specific gravity in air $= S/W$, where $S =$ weight of sample, and $W =$ weight of water.

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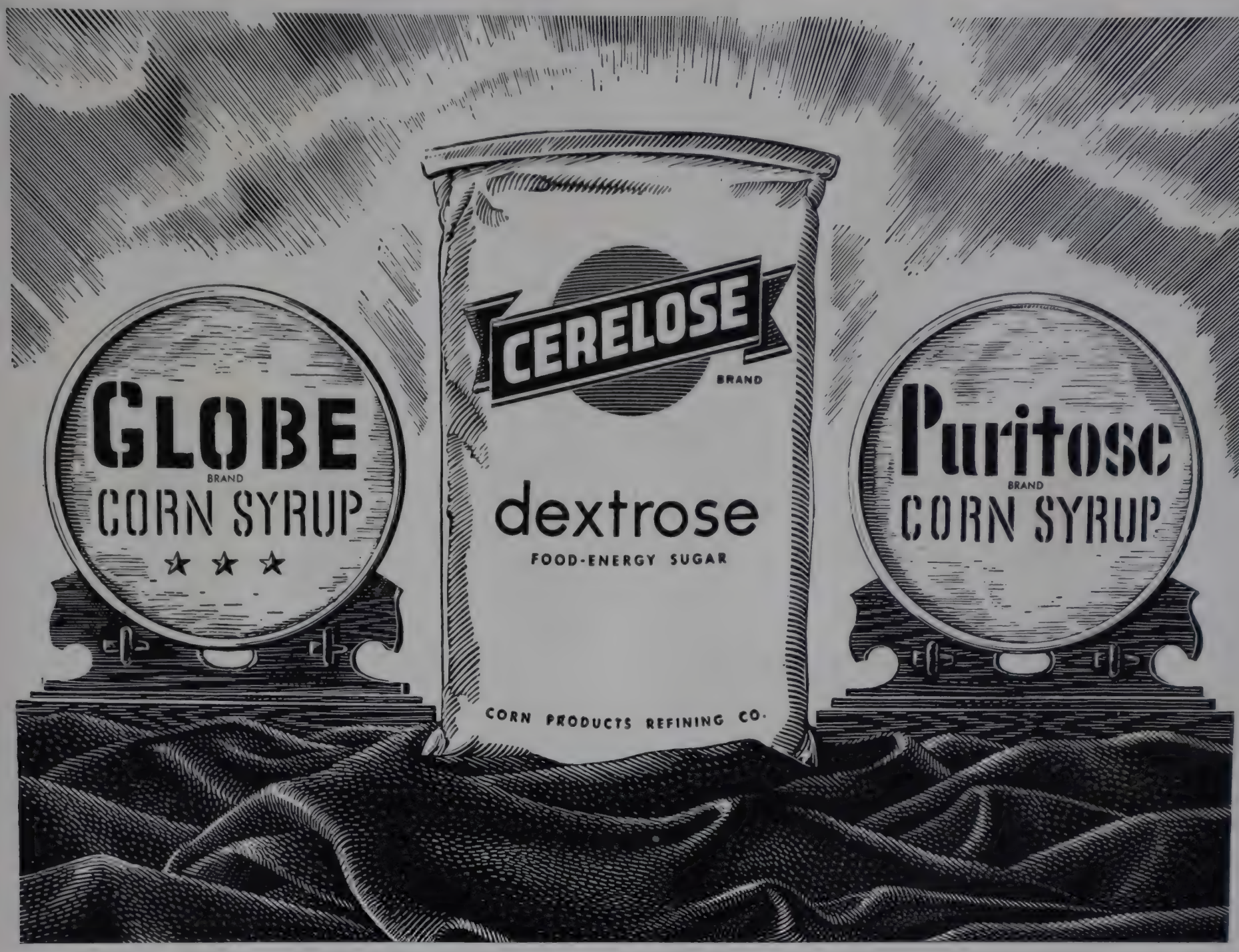

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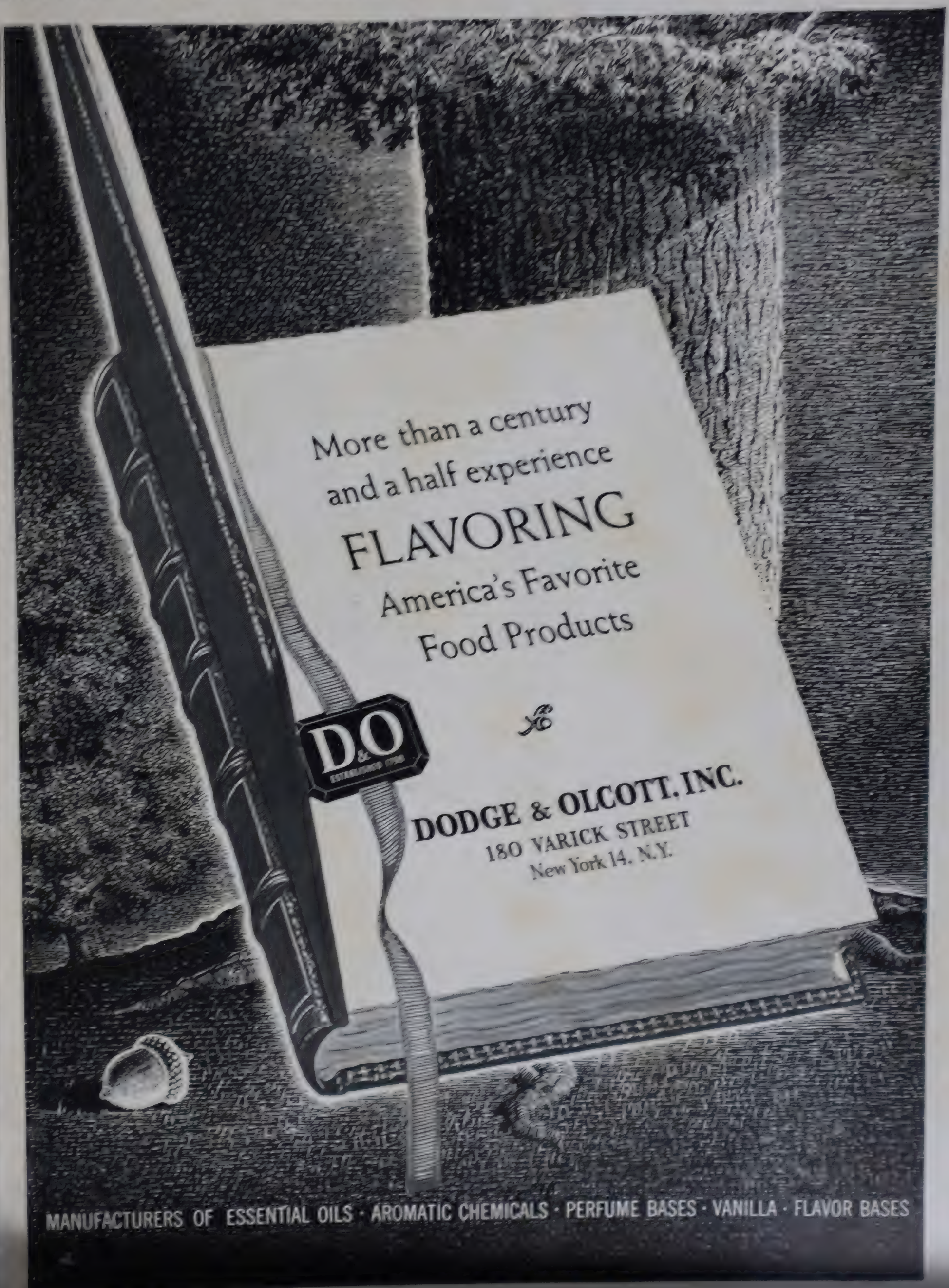
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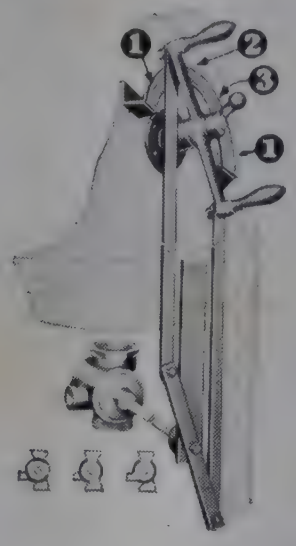
CHILI SAUCE MACHINE

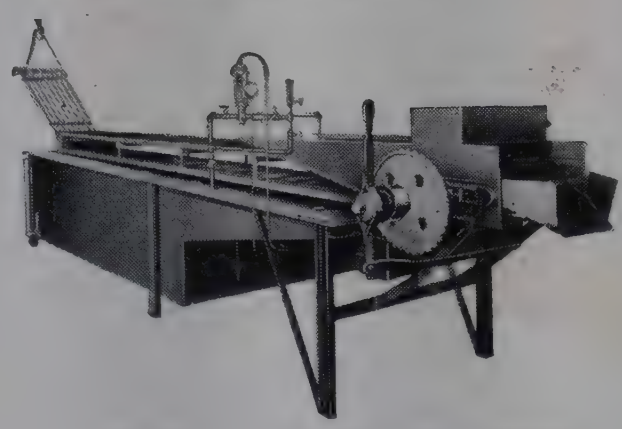
Produces more stock than 30 women per day and greater yield. All essences and seed are obtained giving a higher tomato flavor.

NICKEL ALLOY 3-WAY VALVE



Has but two ports in key. Note position below cut. Eliminates pulling wrong plug or opening valve. No back pressure to lift plug permitting raw stock entering filler line.

HOT WATER SCALDER

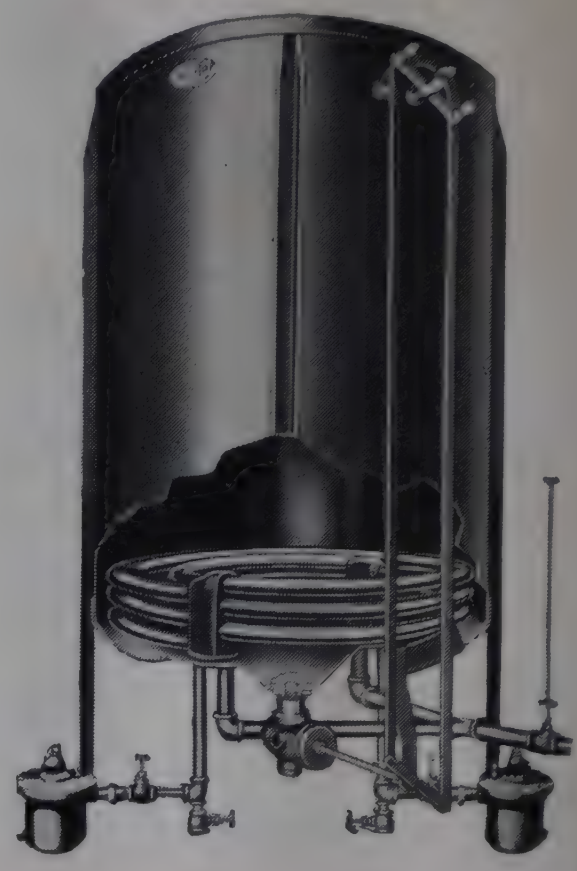


A uniform scald will be obtained increasing efficiency 40%. 1 to 2 additional No. 2 cans of tomatoes will be obtained from each hamper of No. 1's. Pintle chain conveyor riveted to 3/16 x 1" steel bars. Conveyor can be lifted from hot water eliminating cooking of tomatoes. ⅓ water space eliminated. Saving of 70% steam consumption over steam scalder. No cold spots to be cut out.

PADDLE FINISHER

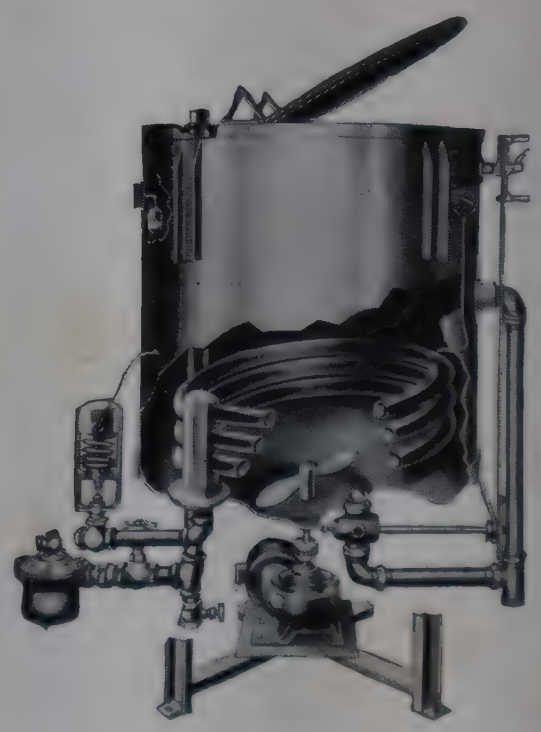
Produces a smooth velvety finish, hook type frame; easy to disassemble for cleaning. Low power consumption. With float ball control eliminating an attendant

STAINLESS STEEL TANK



Equipped with copper, nickel or stainless Kook-More-Koils, 8" dished bottom from which better than five gallon finished product will be obtained from each batch over a wooden tank, assembled there to a 3-way nickel alloy valve controlled from platform.

HOT BREAK TANK



For juice, catsup or puree increases yield and obtains pectin from skin and seeds. For juice set control to 140 degrees, catsup and puree, 170 degrees.

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